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THE MATERIALS OF THE APPALACHIANS.

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PENNSYLVANIA consists almost entirely of massive palæozoic deposits of sand and shale with a few limestones. These beds united reach a thickness greater than do those of the same age in any other known part of the world. Reasonably accurate measurements have given them a total depth in some places of thirty thousand to forty thousand feet. Westwardly they thin off, and on the Ohio line scarcely reach one-fourth part of this enormous depth.

All geologists are agreed that this immense mass of sediment was deposited on the slowly subsiding bottom of the eastern part of an ocean covering the whole interior of North America,—the North American palæozoic ocean, as it may be called for convenience. The extent and form of this ocean varied considerably at different times during its long existence, but taken as a whole it was uninterrupted sea.

It is further a geological truth, so evident as to be now axiomatic, that all this vast mass of palæozoic deposit was obtained by erosion from some contemporaneous palæozoic land. Deposition implies erosion to a precisely equal amount. For every ton of sand or mud deposited on the sea-bottom an equivalent ton has been removed from some land-surface. Sediment is not created. It is only removed. Hence all these huge Appalachian beds from which the mountains have been since carved imply the destruction of exactly equal masses of some more ancient land elsewhere.

It is further admitted, at least, I think, by all Pennsylvania geologists, that this ancient land, whose destruction supplied the materials for these immense deposits, existed to the east and southeast of the Appalachian region. It is sufficient to mention the increasing thickness of the strata towards the southeast and the greater coarseness of their material in the same direction, to convince almost every one that the palæozoic land must be sought there.

Having laid down these premises, I propose first to notice the immense mass of the Appalachian deposit.

Pennsylvania contains at present about forty thousand square miles of surface. Of this about nine-tenths are covered with the palæozoic rocks; that is, about thirty-six thousand square miles. Since their elevation above water erosion has destroyed vast quantities, but, as said above, there is positive evidence that when they lay in horizontal sheets beneath the ancient ocean they measured from eight miles at the east to three miles at the west in depth. It cannot, therefore, be excessive to assume this western measurement as an average over the whole area. If this be done, we find the palæozoic deposits of Pennsylvania represented by a mass three miles thick and thirty-six thousand square miles in area.

This estimate is far below the truth for the following reasons:

1. As mentioned above, nearly the minimum thickness is employed over the whole area.

2. Vast quantities of material now lying outside of Pennsylvania, in Ohio and Western New York, are omitted.

3. The corrugation and consequent contraction of the surface during the formation of the Appalachian earth-folds are disregarded.

The importance of this last fact must not be overlooked. In a paper by the author, read before the British Association at Montreal in 1884, and printed in the AMERICAN NATURALIST for March, 1885, the great diminution of surface which the region in question underwent during the process of crumpling was pointed out. Palæozoic Pennsylvania was far larger than the existing State. Could the strata be flattened out her area would be much increased. Could we iron out—to borrow a term from the laundry—her anticlines and synclines thousands of square miles would be added to her size. The distance from Pittsburg to

Harrisburg would be greater by many miles. The present Keystone State bears to the original palæozoic Pennsylvania somewhat the relation which the skin of a shrivelled apple or potato bears to the same skin when plump and fresh. But of this no account is taken in the estimate given above.

Turning now to the consideration of the land from which all this sediment was derived, we find that only about one-tenth part of the State can have been above water in palæozoic days, and that this small portion lay in the southeastern corner. All the rest is covered with palæozoic rocks. This means that the only visible source of the material of which these rocks are composed and which we have found is a mass of at least thirty-six thousand square miles in surface and three miles thick, is an area in Pennsylvania of four thousand square miles. Restore in imagination these massive sheets of rock to their original source, and it will be necessary to pile the material twenty-seven miles high on the palæozoic land of the State in order to obtain a sufficient supply,—in order to build a quarry from which the rivers and sea-waves of that age could cut out the blocks which, when torn up and scattered, have composed the palæozoic rocks of Pennsylvania.

A correction may be made in the above figures on account of the probability that some of these sediments came from New Jersey on the northeast and Maryland on the south. Parts of both these States consist of archæan terranes now exposed and of others now covered with later mesozoic red sandstones. But if all the areas in both States are added to the possible archæan surface of Pennsylvania, they will not more than double it, and we shall still be compelled to assign an enormous depth (thirteen miles) to the eroded ancient land before sufficient material is at hand to form the palæozoic strata of Pennsylvania.

This, then, is the main factor in the great problem under consideration, the vastness of the mass that has been obtained from the archæan area in the southeast. I wish to take up now only a portion of the subject, one which can be treated in the short space here available. Among these heavy deposits there are, omitting some thin and local beds, four great sandstones, more or less pebbly. They are as follows in descending order:

The Pottsville Conglomerate, Carboniferous.

The Catskill-Pocono Conglomerate, Upper Devonian and Lower Carboniferous.

The Oriskany Sandstone, Lower Devonian.

The Medina Sandstone, Middle Silurian.

All these vary much in thickness in different places, but all are thickest and heaviest and contain the largest pebbles in the eastern or southeastern part of the district, and all thin out, more or less, towards the northwest. To assign to them an average thickness that would satisfy every one is, probably, impossible, but the following attempt will be exact enough for my present purpose. No doubt can be entertained of their original extension over the whole Appalachian area, though all four have since been largely eroded.

The Medina, with the Oneida, maintains its mass over most of its exposures in the State, showing less diminution westward than some of the other strata. It is two thousand feet deep in the Kittatinny, and more than that in the Bald Eagle Range; so that an average of one thousand feet may be safely assumed.

The Oriskany is the thinnest of the four, but its extent is not less than that of the others. In some places it reaches three hundred feet in thickness, but is usually much less. It may be therefore thrown out of our estimate of thickness altogether.

The Catskill—most massive of all, reaching seven thousand feet in many places, consisting of sandstone and shale, and maintaining at its last descent beneath the Alleghany Mountains a thickness of two thousand six hundred feet—may, without danger of exaggeration, be considered the equivalent of another bed of sandstone one thousand feet thick.

The Pocono, varying from more than one thousand feet in the east to two hundred feet in the west, may represent another five-hundred-foot mass.

A similar thickness may be given to the Pottsville, or Carboniferous Conglomerate, and we shall then have, as the equivalent of the great palæozoic sandstones of Pennsylvania, about three thousand feet of sandstone,—a low estimate.

The Catskill and Pocono, having no soft beds between them, may, for our present purpose, be counted as one sandstone mass.

In all these sandstones a part of the mass consists of pebbles of milky quartz. This feature in the Pottsville, Pocono, and Lower Medina is so strongly developed that they usually bear

the name of Conglomerates. The pebbles vary in size from that of a man's fist or larger in the east to that of a hazel-nut or a pea in the west; but they extend over the whole area, and form a considerable part of the mass of the rock. They are as conspicuous in Ohio as in Pennsylvania, and everywhere closely resemble one another.

It would be impossible to form any just estimate of the quantity of these pebbles in the mass of the sandstone. In the first place, their occurrence is uncertain. Over large areas much of the rock is free from them, except in certain, or rather in uncertain, layers; and, secondly, almost everywhere except in the east their proportion, even in the conglomeratic beds, is very variable. Not unfrequently they form seventy-five per cent. of the stone; at other times only an occasional pebble is present. But, scattered as they are over so great an area and through so great a thickness of strata, their whole quantity must be enormous. Were we to assume that they compose only one per cent. of the rock they would equal a bed thirty feet deep, with an area of thirty-six thousand square miles.

Moreover, their rounded form, without a remaining angle in any case, proves two points,—first, that the surviving pebbles have been greatly rubbed down from their original size, especially in the west, and, second, that innumerable fragments have not survived at all, but have been ground into sand by the wear and tear of their long pilgrimage over the ocean-bottom or beach.

In whatever way we regard them, and from whatever point of view, no doubt can be entertained that these pebbles of our Pennsylvania Conglomerates represent, in the whole, a huge mass of milky quartz, and that this, in like manner, represents a larger mass of the same material, from which, by crushing and rolling, they have been derived. Every one is a monument, so to speak, to the memory of an angular block, broken, at some far-distant day, from its parent-ledge, and rolled for years among stones and sand until it was reduced to a smooth, small pebble, and buried to rest in the Conglomerate Rock.

Where was this mass of milky quartz, the parent of the uncounted pebbles of the Conglomerates of Pennsylvania? Milky quartz is not a common mineral in large quantities. I know no source to which they can be ascribed except certain ledges of

this material in the South Mountains, where the pre-palæozoic rocks rise to-day from beneath the overlying strata.

Here, and here only, in Southeastern Pennsylvania can be found the white vitreous quartz of which they are uniformly composed. No other rock can have supplied them. There is abundance of quartz in the gneisses near Philadelphia, and in Chester and other counties, but this quartz is not of the kind from which these pebbles are made, nor does it occur in masses sufficiently large to supply them. Some of the other materials of the palæozoic sandstones may be ascribed to the destruction of the gneiss-rocks. For the white pebbles, however, this origin is not possible.

But though I have thus tracked these pebbles of the Pennsylvanian Conglomerates to their only possible source in the southeast, a serious difficulty stands in the way of further progress. I have, without giving figures, dwelt on their enormous quantity and the vastness of the mass of quartz which they represent. Now, the quartz-ledges of the old rocks in the South Mountains are not thick, measuring only a few feet in most cases. Nor are they numerous. They could never furnish quartz enough to supply even the existing pebbles; and the extinct pebbles—those ground down to sand—must have been even more than those now surviving. If we break up all the quartz-ledges at present existing in the South Mountains, and eke them out with the quartz-veins penetrating like threads the mass of the other strata, these, when rounded into pebbles, will sink into utter insignificance beside the mountain which would rise were all the remaining quartz-pebbles of the Pennsylvanian Conglomerates collected into one place and piled together.

In conclusion, then, it follows from the facts here put forward, whether the figures given be exact or not, that an almost incredible amount of material was eroded from the archæan land of North America during palæozoic days. In no other way can we account for the enormous palæozoic deposits of the Eastern and Midland States. Yet it is not probable that the land ever stood at any dizzy height above the sea. The slow secular depression of which we have so abundant evidence from every part of the globe, and which in this very region has carried Middle Pennsylvania down at least thirty thousand or forty thousand feet below its former level, is quite sufficient to account for the

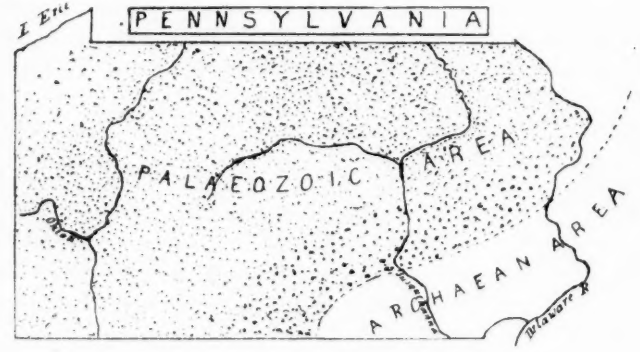
phenomena. Let but the sea-margin, which was the loaded area, sink somewhat faster than the dry land, which was the lightened area, and we have all the conditions that were needed for the erosion and denudation of the relatively rising surface to any required amount. The only limit is some physical change which could put a stop to the rising of the one or the sinking of the other, and this came at the end of palæozoic time, when the Appalachian trough became full.

Another conclusion may be drawn from the facts stated in the second part of this paper. I have pointed out the enormous quantity of white vitreous quartz-pebbles that lie in the palæozoic sandstones of Pennsylvania, and have shown that their only possible known source is the quartz-ledges of the South Mountains. I have also shown that this source is very small when we consider the total mass of the pebbles. It follows, therefore, that at the time when these pebbles were made—that is, during the palæozoic era—there must have been a larger supply of white quartz to afford their material. In other words, the pre-palæozoic rocks, with their quartz-ledges, must have been much more extensive then than they are now. The narrow strip along the South Mountains and their continuation in Pennsylvania, New Jersey, and Maryland, so far as the present subject is concerned, can scarcely exceed one thousand square miles in area. It is hard to avoid the inference that vast masses of ancient strata have totally disappeared from this region. Possibly such masses existed, overlying more or less of the archæan area in the southeast. If so we have at the same time a sufficient quarry from which the rains and waves of that age could obtain their material and a body of rock hard and thick enough to keep them employed during those millions of years.

Any attempt to discuss further the place and extent of this land-surface must be reserved for another time. It may have overlain more or less of the soft gneiss-rocks of Pennsylvania and have been since removed. It may have been crumpled into anticlinal folds with the gneiss, as are now the palæozoic rocks; or it may to a greater or less extent have been contracted in area by the tremendous lateral compressing force to which this region has been subjected. Or, again, one portion to the east may have been shoved over on another to the west, as has happened, we now find, in other parts of the State and in other places in the world. All

this must be left for further investigation. My purpose in this paper has been to show that the sandstone beds of Middle and Western Pennsylvania imply the past existence of quartz-rocks more extensive by far than their present remains would indicate, and that the white pebbles of these Conglomerates imply an immense extension of the ledges of milky quartz that are now to be seen in the rocks of the South Mountains.

In the map and section accompanying this paper an attempt is made to represent to the eye the leading facts in the argument. It is of course quite impossible to draw the latter to scale, nor would any useful purpose be served by the attempt. The uncolored portions show the soft beds lying between the sandstones, which are really in most cases thicker than the sandstones themselves. The only points which the section is intended to bring out are the profound Appalachian trough in which the palæozoic sediments were deposited, the westward thinning of all, both sandstones and shales, and the fining of the Conglomerates in the same direction.



Diagrammatic Section of Pennsylvania from East to West

(To be concluded.)

THE PROGRESS OF ARACHNOLOGY IN AMERICA.

BY LUCIEN M. UNDERWOOD, PH.D.

NOTWITHSTANDING all that is said and written to the contrary, the student of entomology still continues to do miscellaneous work in the "description of new and little known species;" and so long as this miscellaneous fever continues, so long must some one periodically gather up the fragments, in order to save future species-makers the trouble of re-describing what has already been fully described. In these days of such multiplicity of periodical literature it is difficult for the aspiring student—many times far away from the friendly counsel of some one wiser than himself, and away from the larger libraries that would supply many deficiencies—to know what others have already written on any particular family, and where the scattered literature may be found, in order that he may have a substantial basis on which to work. However a worker may modify his views later in life in regard to the proper methods and subjects for investigation, he will invariably develop his *enthusiasm*, if he have any, in a systematic study of some life-group in which his first ambition is to *name* the species of his collection. He may afterwards leave his first love as his mature views cause him to recognize the greater importance of morphological and embryological work, but he will rarely, if ever, commence his entomological career in any other way. Here our leaders in entomology may well take a suggestion, for at the early stages of systematic study too many young persons become hopelessly discouraged who might with proper encouragement become enthusiastic workers. Finding no accessible elementary aids to study, and finding such aids as do exist scattered through volume after volume of "Transactions" never found in their town or college library, they abandon a field in which they might make valuable additions to science for one whose entering pathway seems less beset with difficulties,—*i.e.*, they leave the study of entomology entirely.

Notwithstanding the many valuable papers that have appeared in recent years on our American Hymenoptera, we venture to predict that none of them will do so much to stimulate the study of this most interesting group of insects as Mr. Cresson's

"Synopsis of Families and Genera," which the author too modestly styles a "compilation." The reason is obvious; and those who desire to stimulate the beginner must proceed with eyes open, and bear the necessities of the case in mind.

It has been customary in many groups to publish periodical check-lists, which may possibly serve some useful purpose, but as a rule they are scarcely of a value equal to the labor bestowed upon them, since a little additional labor and a small increase of volume would make of a mere list of names a valuable index to the literature of an order and an outline of its known geographical distribution.

The literature pertaining to the American species of Arachnida, like that on most zoological groups, is exceedingly scattered, and up to the present time no *résumé* has been prepared that will at once place the student in the possession of the always welcome information regarding the present status of the subject.

The first recorded observations on the spiders of the North American fauna were by Lewis Bosc and Thomas Abbot, neither of which reached publication. Bosc left manuscript notes, together with colored drawings of twenty-five Carolina spiders, entitled "Sur les Araignées de la Caroline." The names of his species were published by Baron Walckenaer in 1805, but the descriptions did not appear until the publication of the first two volumes of "Apteres," in 1837. Thomas Abbot, better known by his work on the Lepidoptera, prepared an extensive series of illustrations of Georgian spiders, accompanied by manuscript "Notes and Observations on the Drawings of the Spiders of Georgia." Knowledge of the date of preparation of this series of drawings, as well as of its present place and condition of preservation, is wanting, but it was in London as early as 1802, and was purchased by Baron Walckenaer in 1821. Of the five hundred and thirty-five figures only three hundred could be classified with any certainty by Walckenaer, and the descriptions were published by him in his "Apteres." Very few of these species have been identified in recent times, owing largely, no doubt, to the fact that these southern tramping-grounds of the pioneers of American entomology have never been explored by recent investigators. As many of the species are based on color, which among spiders is exceedingly variable, rather than on more constant structural characters, there are doubtless

many synonymes among them, if, indeed, they can ever be fully identified.

The writings of these pioneers were unknown to Say, who published in 1821 a paper on the lower Arachnida, describing twenty-four species of *Acarina* and eight species of *Arthrogastra.* As we have already published elsewhere bibliographic lists of these two groups,[1] we shall confine the account here given of the literature to the true spiders (*Araneæ*).

The work of Baron Walckenaer has been mentioned already in connection with that of Bosc and Abbot. In the first two volumes of "Apteres" he described two hundred and forty-four North American species, of which two hundred and twenty-six were from Georgia and Carolina. Of these, one hundred and seventy, over two-thirds, are distributed among the four genera,—*Lycosa*, twenty; *Attus*, sixty-six; *Thomisus*, twenty-seven; and *Epeira*, fifty-seven.

Nicholas Hentz began his study of the spiders of the Southern States in 1821, and his publications in the Journal of the Boston Society of Natural History from 1842 to 1850 form the basis of the study of arachnology in this country. These papers, with others by the same author, have since been reprinted in the "Occasional Papers" of the Boston Society (1875). Hentz described two hundred and fifty species, of which one hundred and ninety-nine, or four-fifths, were from the Southern States, chiefly North Carolina and Alabama, where he resided for a long time. Of these, one hundred and fifty have not yet been identified by recent investigators. Add to this number those described by Walckenaer, and we have from the Southern States alone a total of three hundred and seventy-five species of spiders which stand as mere names on our lists, with no specimens anywhere to represent them! As Hentz nowhere mentions Walckenaer's "Apteres," it is more than probable that he was

[1] Preliminary List of the Arthrogastra of North America north of Mexico, in Canadian Entomologist, xvii. 162–169 (September, 1885), and Preliminary List of the Species of Acarina of North America, in Canadian Entomologist, xviii. 4–12 (January, 1886). There are as yet no additions to make to the former, except to note that *Gonyleptes ornatum* Wood has been set aside as a species distinct from *Cynorta ornata* (Say) under the name of *Cynorta sayii* Simon. When the latter list was published, the work of Hallier and J. B. Tyrrell on the Acarina parasitic on birds was unknown to both Professor Osborn and myself. A few species have been since described. These will appear shortly in a supplementary list.

not familiar with it, and that he redescribed some, if not many, of Walckenaer's species.

Nothing more appeared until 1854, when Charles Girard published descriptions of *Mygale hentzii* and *Lycosa pilosa*, collected on Marcy's Red River expedition. The former is the "tarantula" of the Southwest, so commonly found in collections.

Ten years later (1864) Count Keyserling commenced a series of papers, largely on American spiders, which have resulted in some of the most extensive monographs that have appeared on the spiders of this or any land. The first two papers (1864–65) were on the Epeiridæ, or round-web spiders; later have appeared eight shorter papers, the last six (1879–84) forming a series entitled "Neue Spinnen aus Amerika." Most important of all, however, are his elegant quartos, "Die Spinnen Amerikas," of which two volumes have already appeared. The first, on the Thomisidæ, or laterigrade spiders, appeared in 1880, and describes three hundred and fifteen species, of which one hundred and eighteen are new. These are from all America, South as well as North. The second volume, on the Theridiidæ, appeared in two parts (1884 and 1886), and describes three hundred and twenty-five species, of which two hundred and thirty-eight are new. One hundred and thirty-five, including seventy-five new species, are from North America; the remainder are from South America.

In 1869, Giebel described six species of spiders from Illinois, of which four were new. Two years later (1871) Anton Ausserer published extensive notes on the Mygalidæ, or trap-door spiders, of which a considerable number were from America. He gave a revision of the genera, which is now largely followed. In 1875 he published a supplementary paper on the same subject.

In the same year also appeared a paper by John Blackwall on spiders from Canada, describing five new species from the vicinity of Montreal.

Rev. O. P. Cambridge, the well-known author of "The Spiders of Dorset," published in 1874 and 1875 two short papers "On some New Species of Erigone from North America," and in 1881 a paper on "Newfoundland Spiders." In 1874, J. H. Emerton, who has done more in recent times than any other American to bring to light new forms of our spider fauna, commenced publication of the results of his studies. One of his

first efforts was the editing, with valuable supplementary notes, of Hentz's writings, above mentioned. He afterwards (1875) published sundry notes in the AMERICAN NATURALIST on the cave spiders of Virginia, and described two species from Colorado as an appendix to one of Thorell's papers. In 1878 he published a popular elementary work on the "Structure and Habits of Spiders." This was largely used in the preparation of articles which were printed in the Report of the Entomological Society of Ontario for 1879, and in the "Standard Natural History." In 1882 he commenced a series of papers on the spiders of New England, and has already given us valuable monographs of the families Theridiidæ (1882), Epeiridæ (1884), and Lycosidæ (1885). He has in course of preparation papers on the other families of the same region. In these three papers he has described one hundred and seventeen new species, divided among the three families as follows: Theridiidæ, eighty-five; Epeiridæ, twelve; and Lycosidæ, twenty. This unusually large number results from the fact that previous workers had described species largely from the Southern States.

In 1875, Dr. Thorell, well known by his various works on European spiders as well as by various papers on the scorpions and opiliones, published a short "Notice of Some Spiders from Labrador," in which he described seven new species. Two years later (1877) he published a second paper, on the "Araneæ collected in Colorado in 1875 by A. S. Packard;" twenty-six species are described as new; this is almost the only paper that has yet appeared on the spiders of the region west of the Mississippi River.

Rev. H. C. McCook has published, in the Proceedings of the Philadelphia Academy (1876–83), a series of interesting papers on the habits of some of the web-building spiders; these include also the descriptions of some new species.

S. H. Scudder, in 1877, and Dr. George Marx, in 1881, described new species of Lycosidæ, with accounts of their nest-building habits.

In 1883 the Peckhams, of Milwaukee, commenced the publication of new species of Attidæ, or jumping spiders; twenty-five species are described, of which twenty-one are new.

Lastly, in 1886, Professor Atkinson, of Chapel Hill, N. C., in three papers, has described some new Mygalidæ, or trap-door

spiders, from that region; many interesting notes of habits and nests are also given. A few other short papers will be referred to in the classified list of literature given below.

The above descriptive and systematic works describe from the region north of Mexico nine hundred and thirty-five species included in one hundred and thirty-seven genera. (This, of course, excludes those species which have been already reduced to synonymes.) They are distributed in families as follows:

	Genera.	Species.
THERIDIDÆ	44	268
EPEIRIDÆ	16	172
THOMISIDÆ	14	107
ATTIDÆ	12	156
LYCOSIDÆ	9	119
DRASSIDÆ	9	55
MYGALIDÆ	12	23
SPARASSIDÆ	4	7
DYSDERIDÆ	3	5
DICTYNIDÆ	2	6
AGALENIDÆ	2	3
ULOBORIDÆ	2	3
PHOLCIDÆ	2	2
SCYTODIDÆ	1	1
Of uncertain relations	5	8
Totals	137	935[1]

Of course, the above numbers may be somewhat reduced, as a study of Southern forms will cause an identification of Walckenaer's species with those of Hentz, with the usual harvest of synonymes.

So far as is known to us, only five persons are actively engaged in the study of the Arachnida in America.[2] J. H. Emerton is continuing his study of the spider fauna of New England; Professor Atkinson is at work on the Mygalidæ; the Peckhams are studying the Attidæ; and Dr. Marx, of Washington, will soon give us a revision of the scorpions. In Europe, Count Keyserling is continuing his researches, and will doubtless add

[1] If we add to these the two other principal groups of Arachnida as already catalogued, we have:

	Families.	Genera.	Species.
ARANEÆ	14	137	935
ARTHROGASTRA	7	20	59
ACARINA	7	36	121
Totals	28	193	1114

[2] Since the above was written, we learn that Dr. McCook is preparing for the press an extensive work on the spinning habits of American spiders.

much to his already extensive contributions. It would seem that so interesting a group would attract a wider range of students, not only in systematic work, but in the investigation of the deeper and more fundamental questions of morphology and embryology, which offer a field almost wholly unexplored, full of questions waiting to be settled by careful extended study.[1]

In the study of geographical distribution other interesting questions offer themselves. Besides the problem of the spiders of the South above alluded to, which ought to demand immediate attention from some one, the great interior is almost wholly unexplored in reference to its spider fauna; Thorell's few species from Colorado and a few others described by Keyserling represent the condition of our knowledge of this region. From the Pacific coast comes a more pressing need for study, as scarcely a score of species have been described from California.[2]

As among many groups of life forms, both plant and animal, there is greater need of revision of families than there is of the miscellaneous and often hurried description, here and there, of a few "species supposed to be new" by some one only partly familiar with the literature of the subject. We can better afford to wait five or ten years for a monograph of a family prepared by some one who has thoroughly studied and compared the American species, than at the end of the same period to be obliged to search hither and yon for descriptions written by

[1] We would not neglect to mention in this connection the valuable paper by Mr. William A. Locy: "Observations on the Development of *Agelena nævia*," published by the Museum of Comparative Zoology at Cambridge.

[2] If we compare the distribution of a single family, the Epeiridæ, as now known from the various parts of America, it will probably serve as a type of the distribution of the entire group of the Arachnida. Of the one hundred and seventy-two described American Epeiridæ we have:

Of general distribution (at least east of Sierras)	2
Generally distributed east of the Mississippi	25
Confined to Northern States	25
Confined to Southern States (south of Virginia)	93
(This includes seventy-one of Walckenaer's species and fourteen of Hentz's not recently identified.)	
From New England (exclusively)	17
From Mississippi Valley (north)	4
From Rocky Mountain Region (Colorado and Utah)	3
From California	2
From Texas	1

Compared with these figures Simon described seventy-three species in "Les Arachnides de France" and Westring thirty-four species in "Araneæ Suecicæ."

various persons, whose over-anxiety for fame could not resist giving premature birth to "sundry new species."

Meanwhile, well-constructed synopses that represent careful comparisons and will serve as a thorough index to what is known of a subject are not out of place, and will greatly assist beginners in their study. In this matter our American arachnologists may well pattern after the elegant models set them by Simon and Keyserling, in placing a carefully prepared synoptic table of genera and species at the head of each article. A descriptive work without such a synopsis is as faulty as a work of reference without an index or a library without a card catalogue.

In order to render this paper practical for students who desire to enter this attractive group of animal life, we present, first, a synoptic table of families, translated from Simon's admirable "Les Arachnides de France," followed by a summary of the literature of the American species:

ARANEÆ.

SYNOPSIS OF FAMILIES.[1]

A.—Copulatory organ of the ♂ enveloped by the tarsal article of the maliped,[2] which is hollowed in the form of a cupule, or, at least, much enlarged; ♀ with an epigyne[3].....B

Copulatory organ of the ♂ inserted under the tarsal article [of the maliped] without modifying its form; ♀ without an epigyne.....S

B.—Eyes equal or sub-equal, often dissimilar,[4] forming a transverse group wider than deep on the anterior portion of the cephalothorax (sub-order, **Ar. veræ**) E

Eyes unequal, always similar, occupying the entire length of the head, and forming a group as deep or deeper than wide (sub-order, **Ar. oculatæ**).....C

[1] Before an attempt is made to use this table, the reader may, with profit, study the structure of the large spider which commonly builds its nest in the form of a tube with spreading mouth about houses and in the grass. The males will be readily distinguished by their enlarged "palpi." The female reproductive organs will be found at the base of the abdomen below. This spider is the *Agelena nævia*, belonging to the first family under "R."

[2] The *patte-mâchoire* of Simon is, perhaps, best called *maliped;* it is the "palpus" of most American writers.

[3] The *epigyne* represents the whole of the external generative organs of the ♀. In its fundamental form it consists of two sacs, which connect by two little tubes with the oviduct near its mouth, and by two larger tubes with the outside of the spider. *Cf.* Emerton, "Structure and Habits of Spiders."

[4] This refers both to structure and function; two sorts of eyes are found in certain spiders,—(1) convex, round, colored eyes, adapted to diurnal vision, and (2) flat, uncolored eyes of various shapes, adapted to nocturnal vision.

C.—Cephalothorax raised, prismatic; face triangular.....D
Cephalothorax truncate anteriorly; face quadrate; eyes in three rows (4, 2, 2).....**Attidæ.**[1]
D.—Eyes placed in four rows (2, 2, 2, 2).....**Oxyopidæ.**[2]
Eyes placed in three rows (4, 2, 2).....**Lycosidæ.**
E.—Tarsi with three claws.....I
Tarsi with two claws.....F
F.—With three pairs of spinnerets.....G
With only one pair of spinnerets.....PALPIMANIDÆ.
G.—All the eyes similar, diurnal; second pair of legs longer than the fourth, and often than the first.....H
Anterior median eyes diurnal, all the others nocturnal; second pair of legs longer than either the first or fourth.....**Drassidæ.**
H.—Maxillary lamellæ[3] straight; fillet[4] very narrow.....**Sparassidæ.**
Maxillary lamellæ inclined much beneath the anterior portion of the sternum; fillet large.....**Thomisidæ.**
I.—♀ with a calamistrum[5] and a cribellum.....K
♀ with neither calamistrum nor cribellum.....M
K.—Eyes dissimilar, equidistant, forming two parallel lines.....**Dictynidæ.**
Eyes similar, the lateral (at least the posterior) much removed from the median L
L.—Cephalic portion very convex, strongly separated from the thoracic portion; median eyes unequal, forming a compact group, separated from the lateral by two lines.....ERESIDÆ.
Cephalic portion flat, indistinct; median eyes equal, little removed from the lateral of the first row.....**Uloboridæ.**[6]
M.—Tarsi provided with a third article (onychium)[7].....N
Tarsi formed of only two articles.....P
N.—With two pairs of spinnerets, the lower more developed.....ENYOIDÆ.
With three pairs of spinnerets.....O
O.—Spinnerets equal, arranged in a rosette, all of a single article.....**Pholcidæ.**[8]
The upper [spinneret] much longer, formed of two or three articles..HERSILIDÆ.
P.—Fillet as wide or wider than the ocular area.....Q
Fillet narrower than the ocular area.....R
Q.—Cephalothorax oval, elongate, the cephalic portion narrow, raised; spinnerets equal, all formed of a single article.....**Theridiidæ.**
Cephalothorax short, rounded or reniform, the cephalic portion not narrowed; upper spinneret long, of two articles.....UROCTEIDÆ.

[1] Families known to be represented in the United States are in bold-face type, others in small CAPITALS.

[2] This is placed by American writers with the Lycosidæ.

[3] The *maxillary lamellæ* are enlargements of the coxal articles of the malipeds.

[4] The *fillet* is the space between the eyes and the base of the mandibles (*cheliceres.*)

[5] The *calamistrum* is a comb of stiff hairs on the penultimate joint of the fourth leg. The *cribellum* is an additional spinning organ covered with fine tubes and placed in front of the spinnerets.

[6] Emerton, following Blackwall, places the species of this family in the Ciniflonidæ.

[7] The legs in most spiders are formed of seven articles; the onychium, which appears in three families, forms an eighth.

[8] Emerton unites this family with the Theridiidæ.

R.—Median anterior eyes diurnal, all the others nocturnal; ♂ genital article cup-shaped, covering the copulatory organ; epigyne of ♀ in the form of a plate.....**Agelenidæ.**

Eyes (or, at least, the four anterior) all diurnal; ♂ genital article laciniate, encompassing the copulatory organ; epigyne of ♀ provided with a hook or finger.....**Epeiridæ.**

S.—Mandibles (*cheliceres*) inserted vertically, their second articles bending under the internal side; eyes 6, nocturnal (sub-order, **Ar. gnaphosæ**).....T

Mandibles inserted horizontally, their second articles bending longitudinally downward; eyes 8, of which two are diurnal (sub-order, **Ar. theraphosæ**) U

T.—Eyes forming a compact group.....**Dysderidæ.**

Eyes disposed in three separate groups.....**Scytodidæ.**[1]

U.—With a single pair of epigastric stigmata; ♀ with a calamistrum..FILISTATIDÆ.

With two pairs of epigastric stigmata; no calamistrum.....**Avicularidæ.**[2]

The following is a classified arrangement of the principal literature on American spiders, which will summarize what has been somewhat briefly reviewed above. A few of the most important European works are added, as they contain much of general value on the subject:

I. GENERAL.

BARON WALCKENAER.—Histoire Naturelle des Insectes,—Apteres. Tome i. et ii., on Araneina (1837).

N. M. HENTZ.—Descriptions and Figures of the Araneides of the United States; in *Jour. Boston Soc. Nat. Hist.*, iv. 54–57, 223–231, 386–396 (1842–44); v. 189–202, 352–369, 444–478 (1845–47); vi. 18–35, 271–295 (1850). Reprinted with other papers in one volume,—The Spiders of the United States. 8vo. Boston (1875).

CHARLES GIRARD.—Arachnidians; in App. F to Marcy's "Report of Red River Expedition," 233–235 (1854).

C. G. GIEBEL.—Ueber einige Spinnen aus Illinois; in *Zeitschrift für die Gesamm. Naturwissensch.*, 1869, 248–253.

JOHN BLACKWALL.—Notice of Spiders captured by Miss Hunter in Montreal, Upper Canada, with descriptions of species supposed to be new to arachnologists; in *Annals and Mag. of Nat. Hist.* (fourth series), viii. 429–436 (1871).

T. THORELL.—Notice of some Spiders from Labrador; in *Proc. Boston Soc. Nat. Hist.*, xvii. 490–504 (1875).

——Araneæ collected in Colorado in 1875 by A. S. Packard, Jr., M.D.; in *Bull. U. S. Geol. Survey* (Hayden), iii. 477–529 (1877).

J. H. EMERTON.—Cave Spiders from Virginia; in *American Naturalist*, ix. (1875).

——Spiders Common to New England and Europe; in *Psyche*, i. 129–131 (1876).

——Structure and Habits of Spiders. 12mo. Salem (1878). Copious abstracts of this popular work appear in the "Annual Report of the Entomological Society of Ontario" for 1879, and in vol. ii. of the "Standard Natural History."

[1] Emerton unites this family with the Theridiidæ.

[2] More commonly known in this country as the Mygalidæ, or trap-door spiders.

GRAF. EUGENE KEYSERLING.—Amerikanische Spinnenarten aus den Familien Pholcoidæ, Scytodoidæ und Dysderoidæ; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxvii. 205–234 (1877).

——Neue Spinnen aus Amerika, vi. Theile; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxix. 293–350 (1879); xxx. 547–582 (1880); xxxi. 269–314 (1881); xxxii. 195–229 (1882); xxxiii. 649–684 (1883); xxxiv. 489–534 (1884).

O. P. CAMBRIDGE.—Newfoundland Spiders; in *Proc. Royal Physical Soc. Edinb.*, 1881.

II. EUROPEAN.

E. SIMON.—Les Arachnides de France, tome i.–v. Paris (1874–84).

O. P. CAMBRIDGE.—The Spiders of Dorset; with appendix, containing descriptions of those spiders not yet found in Dorsetshire. 2 vols. Sherborne (1879–81).

T. THORELL.—On European Spiders. Part I.—Review of the European Genera of Spiders. Upsaliæ (1869–70).

——Remarks on Synonyms of European Spiders (1870–73).

A. MENGE.—Preussische Spinnen. Danzig (1866–79).

L. BECKER.—Les Arachnides de Belgique. Bruxelles (1882).

WESTRING.—Araneæ Suecicæ (1861).

III. SPECIAL LITERATURE ON LEADING FAMILIES.[1]

A. EPEIRIDÆ.

GRAF. E. KEYSERLING.—Beschreibungen neuer und wenig bekannter Arten aus der Familie Orbitelæ Latr. oder Epeiridæ Sund.; in *Sitzungsber. des Isis zu Dresden*, 1863, 63–154 (1864).

——Beiträge zur Kenntniss der Orbitelæ Latr.; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xv. 799–856 (1865).

J. H. EMERTON.—New England Spiders of the Family *Epeiridæ*; in *Trans. Conn. Acad.*, vi. 295–342 (1884).

B. G. WILDER.—[Notes on *Nephila plumipes*] in *Proc. Boston Soc. Nat. Hist.*, x. 200–210 (1865).

H. C. MCCOOK.—On Webs of New Species of Spiders (verbal communication); in *Proc. Phila. Acad.*, 1876, 200, 201.

——The Basilica Spider and her Snare; in *Proc. Phila. Acad.*, 1878, 124–135.

——The Snare of the Ray Spider (*Epeira radiosa*),—A New Form of Orb-Web; in *Proc. Phila. Acad.*, 1881, 163–175.

——How Orb-Weaving Spiders make the Frame-work or Foundation of Webs; in *Proc. Phila. Acad.*, 1881, 430–435.

——Snares of Orb-Weaving Spiders; in *Proc. Phila. Acad.*, 1882, 254–257.

GEORGE MARX.—Description of *Gasteracantha rufospinosa*; in *Entomologica Americana*, ii. 25, 26 (1886).

See also *Simon*, Les Arachnides de France, tome i.

B. THERIDIDÆ.

GRAF. E. KEYSERLING.—Die Spinnen Amerikas. II. Theridiidæ. 1 Hälfte, Nürnberg (1884). 2 Hälfte, Nürnberg (1886).

[1] Besides the following special papers on each of these families, many species are described in most of the general papers above named, which it is not necessary to repeat here.

O. P. CAMBRIDGE.—On some New Species of *Erigone* from North America 2 parts; in *Proc. Zool. Soc. London.* 1874, 428–442; 1875, 393–405.

J. H. EMERTON.—New England Spiders of the Family *Theridiidæ;* in *Trans. Conn. Acad.*, vi. 1–86 (1882).

See also *Simon*, Les Arachnides de France, tome v.

C. THOMISIDÆ.

GRAF. E. KEYSERLING.—Die Spinnen Amerikas. Laterigradæ. 4to, pp. 283. Nürnberg (1880).

H. C. MCCOOK.—Note on the probable Geographical Distribution of a Spider by the Trade Winds; in *Proc. Phila. Acad.*, 1878, 136–147.

See also *Simon*, Les Arachnides de France, tome ii.

D. ATTIDÆ.

G. W. and E. G. PECKHAM.—Descriptions of New or Little-Known Spiders of the Family Attidæ from various parts of the United States of North America. Pp. 36. Milwaukee (1883).

H. C. MCCOOK.—Note on Two New California Spiders and their Nests (verbal communication); in *Proc. Phila. Acad.*, 1883, 276–278.

See also *Simon*, Les Arachnides de France, tome iii.

E. DRASSIDÆ.

C. L. KOCH.—Die Arachniden Familie der Drassiden. Nürnberg (1866–68).

O. P. CAMBRIDGE.—On some New Species of Drassides; in *Proc. Zool. Soc. London*, 1874, 370–419.

See also *Simon*, Les Arachnides de France, tome iv.

F. LYCOSIDÆ.

GRAF. E. KEYSERLING.—Ueber Amerikanische Spinnen Arten der Unterordnung Citigradæ; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxvi. 609–708 (1876).

J. H. EMERTON.—The Lycosa at Home; in *American Naturalist*, iv. 664, 65 (1870).

——New England Spiders of the Family *Lycosidæ;* in *Trans. Conn. Acad.*, vi. 481–505 (1885).

S. H. SCUDDER.—The Tube-Constructing Ground-Spider of Nantucket; in *Psyche*, ii. 2–9 (1877).

GEORGE MARX.—On some New Tube-Constructing Spiders; in *American Naturalist*, xv. 396–400 (1881).

H. C. MCCOOK.—Note on the Intelligence of the American Turret-Spider (verbal communication); in *Proc. Phila. Acad.*, 1883, 131, 132.

See also *Simon*, Les Arachnides de France, tome iii.

G. MYGALIDÆ.

S. B. BUCKLEY.—The Tarantula and its Destroyer; in *Proc. Amer. Entom. Soc.*, i. 138, 139 (1862).

ANTON AUSSERER.—Beiträge zur Kenntniss der Arachniden Familie der Territelariæ Thorell; in *Verhandl. d. k. k. zool.-bot. Gesellschaft*, xxi. 117–224 (1871).

——Zweiter Beitrag zur Kenntniss der Arachniden Familie der Territelariæ Thorell. *Ibid.*, xxv. 125–206 (1875).

J. T. MOGGRIDGE.—Harvesting Ants and Trap-Door Spiders; with Supplementary Descriptions of Species by Rev. O. P. Cambridge. London (1873–74).

H. C. MCCOOK.—Restoration of Limbs in Tarantula; in *Proc. Phila. Acad.* 1883, 196, 197.

GEORGE F. ATKINSON.—A New Trap-Door Spider; in *American Naturalist*, xx. 583–593 (1886).

——A Family of Young Trap-Door Spiders; in *Entomologica Americana*, ii. 87–92 (1886).

——Descriptions of some New Trap-Door Spiders, their Notes (*sic*) and Habits; in *Entomologica Americana*, ii. 109–117, 128–137 (1886).

SYRACUSE UNIVERSITY, August, 1887.

HISTORY OF GARDEN VEGETABLES.

BY E. LEWIS STURTEVANT, A.M., M.D.[1]

(Continued from page 912.)

EGG-PLANT. *Solanum melongena* L.

THE egg-plant seems not to have been known in Europe in the time of the ancients. The Arab physician, Ebn Baithar, who wrote in the thirteenth century, speaks of it, and cites Rhases, who lived in the ninth century.[2] Albertus Magnus,[3] who lived in Europe in the thirteenth century, mentions it,—"Et sic inveninutur tres sapores in melangena, amarus acutus et stypticus." Ibn-al-awan, a Moorish Spaniard of the twelfth century, describes four species, and the Nabatheenne agriculture six.[4] According to Jessen,[5] Avicenna, who flourished about A.D. 595, knew it, and called it Badingan. This latter word, variously spelled, is the present name in Hindustanee, Arabic, Persian, and Sumatran,[6] and the closely corresponding English[7] name in India is Brinjal, and Begoon;[8] in Spain, Berengena; or at San Domingo, Beringene.[9] Bretschneider[10] says the egg-plant can be identified in the "Ts'i min yao shu," a Chinese work on

[1] Director of the New York Agricultural Experiment Station, Geneva.

[2] De Candolle, Orig. des Pl. Cult., 229.

[3] Albertus Magnus, De Veg., Jessen ed., 1867, 204.

[4] Ibn-al-awan, Le Livre d'Agriculture. Trans. of Clement-Mullet, 1886, ii. pt. 1, pp. 236–239.

[5] Albertus Magnus, l. c., note.

[6] Birdwood, Veg. Prod. of Bombay, 173.

[7] Drury, Useful Pl. of Ind., 410.

[8] Firminger, Gard. in Ind., 155.

[9] Heuze, l. c., ii. 695.

[10] Bretschneider, Bot. Sin., 59.

agriculture of the fifth century, and is described in later writings of 1590, 1640, and 1742. Acosta[1] mentions, as among the vegetables carried from Spain to America, the "Becengenes, or apples of Love;" and Piso,[2] in 1658, figures the egg-plant among Brazilian plants, under the name of Belingela.

The various European names are given as below: in Belgian, *veramgenes, eierplant;* in English, *apples of love, madde apples, egg-plant;* in France, *albergine, avbergine, beringene, brehheme, bringele, magrinan, mayenne, melanzane, merangene, meringeane, verinjeane, viadase;* in Germany, *Eierpflanze;* in Italy, *petonciano, melanzacca, maringiani;* in Portugal, *bringela;* in Spain, *berengena.*[3]

These names are largely derived from the Arabic *melongena,*[4] as given by Rauwolf.

The egg-plants first known in Europe appear to belong to the class we now grow for ornament, and the fruit resembling an egg. They were of various colors. Fuchsius (1542) mentions the purple and the yellow; Tragus (1552), who says they have recently reached Germany from Naples, names the same colors; Lyte's "Dodoens" (1586) reads two kinds,—one purple and the other pale or whitish. In 1587, Dalechamp figures three kinds,—the one long, another obscurely pear-shaped, and the third rounded,—and mentions the colors purple, yellow, and ash-colored; Gerarde (1597) says white, yellow, or brown; Dodonæus (1616) mentions the oblong and round, white and purple; Marcgrav, in 1648, describes a round and yellow fruit; J. Bauhin (1651) names various sorts,—the long, the deep, and the round, yellow, purple, and whitish. Bontius, in 1658, describes the wild plant of Java as oblong and round, or spherical, the color yellow; the cultivated sorts purple or white, etc. Rauwolf, who particularly described these plants at Aleppo in 1574, as ash-colored, yellow, and purple.

At present the purple egg-plant is almost the only color grown in our kitchen-gardens, but there are many sorts grown in other regions. The purple and the white ornamental are named for American gardens in 1806, as also in England in 1807, in France in 1824, etc. In the Mauritius, Bojer[5] names

[1] Acosta, Hist. of the Ind., Eng. ed., 1604, 294.
[2] Piso, De Ind. Utrinsque, 1658, 210.
[3] Vilmorin, Les Pl. Pot., 23.
[4] Rauwolf, Ex Bauh., Phytopin., 1596, 300.
[5] Bojer, Hort. Maurit., 240.

three varieties, and the purple and white colors. In India, Carey[1] says, there are several varieties in constant cultivation by the natives, such as green, white, purple, yellow, etc. Firminger[2] describes purple-, black-, and white-fruited forms; and Speede[3] names the purple and white in six varieties. In Cochin China, Loureiro describes five sorts, purple, white, and variegated.

There are two sorts of plants to be recognized,—(*a*) the one with the stems, leaves, and calyxes unarmed, or nearly so; (*b*) the other with the stems, leaves, and calyxes more or less aculeate.

a. The first sort is figured by Fuchsius (1542), and by succeeding authors up to the present date.

b. The second sort is first noticed, so far as I can ascertain, by Camerarius in 1588, and has continued to the present time.

The varieties now grown in American gardens can be divided very readily into four types,—the oval, the round, the long, and the oblong or pear-shape,—and the following synonymy can be established:

I. The *Oval.* This, at present, includes but ornamental sorts, and our present forms show a marked improvement in evenness and regularity over the older forms.

a. CALYX NOT SPINY.

Mala insana. Fuch., 1542, 513; Roszlin, 1550, 117; Tragus, 1552, 894; Pinæus, 1561, 514; Ger., 1597, 274; Swertius, 1612, t. 20, p. 1; Dod., 1616, 458.

Melangena sive mala insana vel melanzana. Lob. Obs., 1576, 138; *ic.*, 1591, i. 268.

Melongena, seu mala insana. Cam., Epit., 1586, 820.

Melongena. Matth., Opera., 1598, 760.

Melanzane. Cast. Dur., 1617, 279.

Solanum pomiferum fructu rotundo. J. Bauh., 1651, iii. 618.

Melongena arabum. Chabr., 1673, 524.

Aubergine blanche. Vilm., 1883, 27.

b. CALYX SPINY.

Melanzana fructu pallido. Hort. Eyst., 1713; Aut. Ord., i. p. 3; also *ib.*, 1613.

White Egg-Plant. N. Y. Sta., 1886.

II. The *Round.*

[1] Carey, Hort. Beng., 16.

[2] Firminger, Gard. in India, 155.

[3] Speede, Indian Handb. of Gard., 177.

a. Calyx not Spiny.

Belingela. Marcg., 1648, 24; Piso, 1658, 210.
Aubergine ronde de Chine. Decaisne & Naudin, Man., iv. 288.
Black Pekin. Ferry, 1883; Hovey, 1866.

b. Calyx Spiny.

Black Pekin. Greg., 1886; Thorb., 1886.

III. The *Long*. This varies much in size and proportion,—if the Chinese variety described by Kizo Tamari[1] as recently introduced into Japan belongs to this class. He says it is about one inch in diameter by one foot and a half long. This form may be either straight or curved.

a. Calyx not Spiny.

Melantzana arabum melongena. Lugd., 1587, ii., app., 23.
Solanum pomiferum fructu incurvo. J. Bauhin, 1651, iii. 619; Chabr., 1673, 524; Pluk., Phyt., 1691, t. 226, p. 2.
Aubergine violette longue. Decaisne & Naudin, Man., iv. 287.

b. Calyx Spiny.

Aubergine violette longue. Vilm., 1883, 24.

IV. The *Oblong*, or *Pear-Shaped*. This form is a swollen fruit with an elongation towards the summit, in some of its varieties shaped like the powder-horn gourd.

a. Calyx not Spiny.

Melantzana nigra. Lugd., 1587, ii., app., 23.
Aubergine violette nain tres hative. Vilm., 1883, 26.
Early Round Violet. Damman, 1884.

b. Calyx Spiny.

Solanum pomiferum magnus fructu, etc. Pluk., Phyt., 1691, t. 226, p. 3.
Melongena. Tourn., 1719, t. 65.
American Large Purple. Burr, 1863, 609.

We may note that the Arabic words melongena and Bedengiam were applied by Rauwolf to the long-fruited form, the

[1] American Horticulturist, Sept. 1886, p. 10.

calyx not spiny, while the word Batleschaim, or Melanzana Batleschaim, was applied to the spiny-calyx form of the pear-shaped, —if Gronovius's[1] synonymy is to be trusted.

Every type in the varieties that I have seen under cultivation can be, with certainty, referred to one of the four forms above named. The oval-form type is figured in 1542, as we have shown; the round type in 1648, in Brazil; the long type, by Dalechamp, in 1587; and the pear-shaped type also in 1587. All the colors now noted, and more, receive notice in the ancient writers. As we have confined our synonymy to those authors who have given figures, and have omitted those who but described, however certainly the descriptions would apply, we can claim accuracy as to our facts.

We, hence, have no evidence that types have originated through cultivation in recent years, and we have strong evidence that types have continued unchanged through long-continued cultivation under diverse climates. It is but as we examine variation within types that we see the influences of cultivation. It is not altogether in size. The oval-fruited is described by Dodonæus (1616) as of the form and size of an egg, but he says that in Ægypt, where the plant is wild, it attains double or three times this size, which it has in France and Germany. Ray, in 1686, compares the size of the long-fruited to that of an egg, or of a cucumber,—a comparison that would answer for to-day, as cucumber size covers a wide range; but he adds that the curved form is like a long gourd. The figures of the pear-shaped in 1719 indicate a fruit which compares well with the usual sizes grown at the present time. It is in regularity of form, and in the large size of selected strains, that we see the influence arising from careful selection and protected growth. What other influence has climate exercised? We do not know.

This sketch illustrates the point I have already made in my study of the dandelion, celery, and other vegetables,—that types of varieties have great fixity, are not produced through human selection and cultivation, and, I wish I could add in this case, originated from wild prototypes; but, unfortunately, I find no particular records of the variation observed in feral, or spontaneous plants.

[1] Gronovius, Orient., 25, 26.

ELECAMPANE. *Inula helenium* L.

The use of this plant is now nearly abandoned, although it was once highly regarded as an aromatic tonic. Columella, Pliny, and Palladius mention its culture by the Romans of the first and third centuries. Vegetius Renatus, about the beginning of the fifth century, calls it *Inula campana*, and St. Isidore, in the beginning of the seventh, names it *Inula*, adding "quam *Alam* rustici vocant." It is frequently mentioned in Anglo-Saxon writings on medicine before the Norman conquest, and was the "marchalan" of the Welsh physicians of the thirteenth century, and was generally well known during the middle ages.[1] The root is the valuable part, and it was used for candying into a sweetmeat, as well as for a medicine, and is sometimes even now used in distilling *absinthe* in order to give a flavor. It was in American gardens in 1806,[2] and its seed is yet advertised in some of our seed-catalogues.

The *Elecampane* is called, in France, *aulnée*, *aromaté germanique*, *aunée*, *œil-de-cheval;* in Germany, *alant;*[3] in Anglo-Saxon, *hors-helene;* in Italy, *elenio* or *enula campana*.[4]

The plant, now naturalized in places in the United States, is native to Southern and Central Europe, extending eastward to the Caucasus, Southern Siberia, and in the Himalayas. It also occurs in Southern England and Ireland, Norway, and Finland.

ENDIVE. *Cichorium endivia* L.

There are two distinct forms of endive,—the one the curled, the other the broad-leaved. The first does not seem to have been known to the ancients, although Dioscorides[5] and Pliny[6] name two kinds. In the thirteenth century Albertus Magnus[7] names also two kinds, the one with narrower leaves than the other; and in 1542 Fuchsius[8] figures two kinds of like description, and like forms are noted in nearly all the earlier botanies. A curled broad-leaved form is figured by Camerarius[9] in 1586; Dalechampius,[10] 1587; Gerarde,[11] 1597, etc. It is, however,

[1] Pharmacographia, 1879, 380.
[2] McMahon, Am. Gard. Kal., 1806.
[3] Vilmorin, Les Pl. Pot., 28.
[4] Pickering, Ch. Hist., 461.
[5] Dioscorides, lib. ii. c. 147.
[6] Pliny, lib. xx. c. 29, 32.
[7] Albertus Magnus, De Veg., Jessen ed., 1867, 508.
[8] Fuchsius, De Stirp., 677, 678.
[9] Camerarius, Epit., 1586, 283.
[10] Hist. Gen., Lugd., 1587, 557.
[11] Gerarde, Herbal, 1597, 221.

described in the "Adversaria,"[1] 1570. These authors named all furnish what may reasonably be considered as the types of the four kinds of broad-leaved endives now described by Vilmorin.[2] The origin of the curled endives, of which Vilmorin describes twelve, I find difficult to trace. The peculiar truncate appearance of the seed-stalks is very conspicuous, and this feature would lead me to suspect that the type is to be seen in the *Seris sativa* of Lobel[3] (1576), but the resemblances, I must confess, are quite remote. This is the *Cichorium latioris folii* of Dodonæus[4] (1616). They were in English gardens as a well-known sort in 1778,[5] and were named among seedsmen's supplies in 1726;[6] in the United States prior to 1806.[7]

The endive is called, in France, *chicorée endive;* in Germany, *endivien, winter-endivien;* in Flanders and Holland, *andijvie;* in Denmark, *endivien;* in Italy, *indivia, endivia;* in Spain, *endivia, escarola;* in Portugal, *endivia.*[8] The curled forms are called, in France, *chicorées;* the broad-leaved form, *Scaroles;* in English, *Batavian;* in Arabic, *Sjikuri;* by Turks, *hiddiba;*[9] in Egypt, *hendibe;* in Egyptian, *saris, serin;*[10] in India, *kasnee;*[11] in Japan, *fanna tsisa;*[12] Hindustani, *kasni;* Tamil, *koschi.*[13]

In 1885, a curled endive, at the New York Agricultural Experiment Station, was crossed by lettuce-pollen. The crop of 1886 showed a plant resembling the lettuce in leaf, but with the flower of the endive. We may explain this result as being a case of atavism, the stimulus of the foreign pollen bringing out one of the lettuce-like broad-leaved forms, which had shared in the parentages from which the curled was evolved.

English Bean. *Vicia faba* L.; *Faba vulgaris* Moench.

The culture of the English or broad-bean precedes the period of written history, as the seeds have been found not only in the Egyptian tombs of the twelfth dynasty, or from two thousand

[1] Pena and Lobel, Adv., 1570, 86.
[2] Vilmorin, The Veg. Gard., 1885, 243, 244.
[3] Lobel, Obs., 1576, 114.
[4] Dodonæus, Pempt., 1616, 634.
[5] Mawe, Gard., 1778.
[6] Townsend, Seedsman, 1726, 20.
[7] McMahon, Am. Gard. Kal., 1806.
[8] Vilmorin, Les Pl. Pot., 89.
[9] Forskal, Fl. Ægypt-Arab., xxx.
[10] Pickering, Ch. Hist., 257.
[11] Speede, Ind. Handb. of Gard., 167.
[12] Thunberg, Jap., 304.
[13] De Candolle, Orig. Des Pl. Cult., 78.

two hundred to two thousand four hundred years before Christ,[1] and have been excavated from the ruins of Troy,[2] but appear among the débris of the bronze age of the lake-dwellers of ancient Switzerland,[3] and the variety found continued to the times of the Romans.[4] Beans were also found at Teneriffe[5] at the period of the discovery; and Bretschneider[6] records that, about 140–86 B.C., during the reign of the Emperor Wu-ti, the celebrated general Chang-kien brought the bean from Western Asia; but these were probably only better varieties than those then grown in China. The bean was grown by the ancient Romans and Greeks, and finds frequent mention in their writings, and in Egypt was subject to many superstitious beliefs and prejudices.[7] This bean is now more or less cultivated in all quarters of the globe. It reached the British North American Colonies early in the seventeenth century, having been planted by Gosnold in the Elizabeth Islands, near the coast of Massachusetts, in 1602. Beans were under cultivation also in Newfoundland as early as 1622, in New Netherlands in 1644, and in Virginia prior to 1648.[8] At the present time Vilmorin[9] describes twelve garden and four field varieties as worthy of culture in France. In England this bean is very extensively grown. Dr. Alefield[10] had separated forty varieties in 1862. In America they are but little grown, and our best seed-catalogues enumerate no more than four varieties.

Linnæus forms this bean into two botanical varieties, as does also Moench, who names the one *hortensis*, or the garden bean; the other *equina*, or the horse-bean. These are both figured or mentioned by the early botanists: the *hortensis* or garden bean by Fuchsius (1542), Tragus (1552), etc.; the *equina* is described by Pena and Lobel in their "Adversaria" (1570), and by Lyte in his "Dodoens" (1586), as well as by Dodonæus in 1566.

[1] G. Schweinfurth, Nature, Jan. 31, 1883, 314.

[2] De Candolle, Orig. Des Pl. Cult., 272.

[3] Gard. Chron., 1866, 1068; De Candolle, Orig. Des Pl. Cult., 255.

[4] Darwin, An. and Pl., 1868, i. 385.

[5] Gen. Coll. of Voy. of the Port, London, 1789, 183.

[6] Bretschneider, On the Study, etc., 15.

[7] For an excellent summary, see "Travels of Anacharsis," Phila., 1804, iv. 154–157.

[8] U. S. Pat. of Rept., 1553, 221. [9] Vilmorin, Les Pl. Pot., 1883, 210.

[10] Alefield, Bonplandia, x. 1862, s. 348; quoted from Darwin, l. c.

I am too unfamiliar with the English bean to attempt a synonymy. R. T[1][hompson], in 1850, describes ten varieties, giving synonymes, and these include all sufficiently known to him. Let us follow up his synonymy, in order to see whether varieties of modern origination appear. This synonymy, we must caution, is founded upon identity of names in the most instances, and applies to the garden bean only, yet collateral evidence would seem to indicate a substantial correctness:

1. *Early mazagan.* R. T., 1850. Brought from a settlement of the Portuguese on the coast of Africa, just without the Straits of Gibraltar. Mill. Dict., 1807.
   Early mazagan. Mawe, 1778; Bryant, 1783; McMahon, 1806; Thorb. Cat., 1828; Thorb. Cat., 1884.
   Feve naine hative. Noisette, 1829; Vilm., 1882.

2. *Marshall's Early Dwarf Prolific.* R. T., 1850.

3. *Long-pod.* R. T., 1850.
   Long-pod. McMahon, 1806.
   Early long-pod. Mawe, 1778; Bridgeman, 1832; Loudon, 1860.
   Early Portugal or *Lisbon.* Mawe, 1778; Mill. Dict., 1807.
   Early Lisbon. McMahon, 1806; Bridgeman, 1832.
   Turkey long-pod. Mawe, 1778; McMahon, 1806; Bridgeman, 1832.
   Tall long-pod. Mawe, 1778.
   Sandwich. J. W., Gent., 1683; Townsend, 1726; Stevenson, 1765; Mawe, 1778; Bryant, 1783; Bridgeman, 1832.
   Sword long-pod. Thorb. Cat., 1828; Fessenden, 1828; Bridgeman, 1832; Thorb. Cat., 1884.
   Hang-down long-pod. Vil., 1883.
   Feve à longue cosses. Noisette, 1829; Vil., 1883.

4. *Green long-pod.* R. T., 1850.
   Green Genoa. McMahon, 1806; Bridgeman, 1832.
   Green Nonpareil. McMahon, 1806; Thorb., Gard. Kal., 1821; Fessenden, 1828; Bridgeman, 1832; Thorb. Cat., 1884.

5. *Dutch long-pod.* R. T., 1850; Loudon, 1860.

6. *Windsor.* R. T., 1850.
   Broad Windsor. Mill. Dict., 1807; Fessenden, 1828; Loudon, 1860; Thorb., 1884.
   Kentish Windsor. Bridgeman, 1832.

[1] R. T., Gard. Chron., 1850, 84.

Taylor's Windsor. Bridgeman, 1832.
Mumford. Mawe, 1778; Bryant, 1783; McMahon, 1806; Bridgeman, 1832.
Small Spanish. Mawe, 1778; Bryant, 1783.
Windsor. Stevenson, 1765; Mawe, 1778; Bryant, 1783.
Large Windsor. Van der Donck, 1653; in present New York.

7. *Green Windsor.* R. T., 1850.
Toker. Stevenson, 1765; Mawe, 1778; Bryant, 1783; Bridgeman, 1832.
Feve de Windsor verte. Vil., 1883.

8. *Green China.* R. T., 1850.

9. *Dwarf Crimson-seeded.* R. T., 1850.
Feve très naine rouge. Vil., 1883.

10. *Dwarf Fan.* R. T., 1850.
Dwarf Fan or *Cluster.* Mawe, 1778.
Dwarf Cluster. McMahon, 1806; Bridgeman, 1832.
Feve naine hative à chassiz. Vil., 1883.

11. *Red-blossomed.* Mawe, 1778; McMahon, 1806; Bridgeman, 1832; R. T., 1850.

12. *White-blossomed.* Mawe, 1778; McMahon, 1806; Bridgeman, 1832; R. T., 1850.

The only two other varieties I have seen advertised lately are Beck's Dwarf Green Gem and Seville long-pod.

There is certainly no indication here that types have appeared in modern culture. The crowd of new names which appear during a decade gradually become reduced to a synonymy, and we find at last that the variation gained has been within types only.

The European names of the broad-bean, or English bean, are: Denmark, *valske bonner;* in Flanders, *platte boon;* in France, *feve, gorgane, gourgane;* in Germany, *Garten bohnen, sau bohnen, puff bohnen;* in Holland, *tuin boonen, roomsche boonen;* in Italy, *fava;* in Portugal, *fava;* in Spain, *haba.*[1] Other generic names are: Arabic, *ful* or *foul;* Hebrew, *phul* or *pol;* Celtic, *fa, fas, fav;* Slav, *bob* or *bobu;* Berber, *ibiou;* Basque, *baba.*[2]

[1] Vilmorin, Les Pl. Pot.

[2] De Candolle, Geog. Bot., 956; Orig. Des Pl. Cult., 253.

The horse-bean is called, in France, *feverole;* in Germany, *pferde oder feld bohne;* in Italy, *fava cavallina.*[1]

EVENING PRIMROSE. *Œnothera biennis* L.

The roots may be used as Scorsonera, but it is cultivated in France only as a curiosity.[2] It is said by Loudon[3] to be cultivated in Germany, and in Carniola the roots are eaten in salad.[4] It was once under English culture.[5] A native of Northern America, it first reached Europe in 1614.[6] It is given by Burr[7] for American gardens in 1863, under the name *German Rampion.*

It is called, in France, *Œnothere bisannuelle, onagre, herbe aux anes, jambon, jambon des jardiniers, jambon de St. Antoine, lysimachie jaune, lysimachie jaune cornu, mache rouge;* in Germany, *rapuntica;* in Flanders, *ezelskruid;* in Italy, *rapontica, rapunzia;* in Norway, *natlys.*[8]

(To be continued.)

THE PERISSODACTYLA.

BY E. D. COPE.

DIPLARTHRA.

IT is to the order Diplarthra that the greater number of existing species of hoofed mammals belong. It is represented by two sub-orders, which have the following definitions:

Astragalus truncate distally; the median toe the largest;.....*Perissodactyla.*
Astragalus with the distal end convex anteroposteriorly, forming a ginglymus (hinge-joint); number of toes generally even, the median two the largest;.....*Artiodactyla.*

[1] NOTE.—The references in the list are to Bridgeman, Young Gard. Assist., N. Y., 1832; Bryant, Fl. Dict., Lond., 1783; Fessenden, New Am. Gard., 1828; Loudon, Hort. Lond., 1860; McMahon, Am. Gard. Kal., Phila., 1806; Mawe, Univ. Gard., Lond., 1778; Noisette, Man., Brussels, 1829; Stevenson, New and Comp. Gard. Kal., Dublin, 1765; Thorburn, Gent. and Gard. Kal., N. Y., 1821; Thorburn's seed-catalogues, 1828, 1884; Townsend, Comp. Seedsman, Lond., 1726; Vilmorin, Les Pl. Pot., Paris, 1883.

[2] Vilmorin, Les Pl. Pot., 202.
[3] Loudon, The Horticult., 1860, 653.
[4] Flore Nat. et Econ., Pt. 2, p. 398.
[5] Johnson, Useful Pl. of Gt. Brit., 104.
[6] Linnæus, Sp., 1763, 492.
[7] Burr, Field and Gard. Veg., 1863, 35.
[8] Schubeler, Culturpflanz de Norv., 118.

No undoubted connecting forms between these sub-orders have been discovered, although they approximate at various points. Thus, in the genus Menodus there are but four toes in the anterior foot, and the median two do not differ much in length. In the same genus the distal extremity of the astragalus is somewhat convex, and the facet for the cuboid bone is large, somewhat as in the hippopotamus; but the angle separating the two facets is diagonal, and not transverse; so that the astragalus cannot move on the cuboid and navicular bones and form a ginglymus, as it does in the Artiodactyla. In a few instances some Artiodactyla have teeth which resemble those of the Perissodactyla; for instance, the genus Listriodon. Both sub-orders probably arose from an undiscovered common ancestor, which was a member of the order Amblypoda. It was probably a type with tubercular molars, and belonged to the Puerco epoch. An approach to this theoretical type is made by the Pantolestidæ, whose molars are bunodont, the superior molars being tritubercular (with two intermediates); but the form of the extremities (the posterior only is known) is that of the Diplarthra. The hypothetical Amblypoda with bunodont molars I have regarded as a sub-order, and have named the Hyodonta.[1]

The opinion has been expressed by Schlosser that the evolution of the Diplarthra, or alternate-wrist-and-ankle-jointed ungulates, has been directly from the Taxeopoda, or straight-rowed-wrist-and-ankle-jointed Ungulata, without intervention of the Amblypoda. The Periptychidæ have been cited as the probable ancestors of the Artiodactyla, and the Phenacodontidæ as ancestors of the Perissodactyla. I do not agree with this view, and for the following reasons:

The conversion of a taxeopod into a diplarthrous ungulate has been accomplished by the rotation outwards of the lower leg with the first row of the carpus and tarsus, on the second row, or by the rotation inwards of the second row on the first, in both the fore and hind feet. This rotation has resulted sooner or later in the loss of the internal digit (thumb and great toe) from both extremities. In the history of this sliding outwards of the first row, the outside element of the row has always preceded in time the inside element. The Amblypoda (Fig. 2)

[1] Proceeds. Amer. Philosoph. Society, 1882, 446.

PLATE XXVIII.

Hyæna striata, striped hyena.
(From the Standard Natural History.)

show this clearly. The lunar bone has extended outwards so as to rest on the outside bone of the second row (unciform) in part, as well as the one on which it properly rests (magnum). But the scaphoid has not slipped outwards so as to rest on the magnum of the second row. That continues to rest on its proper successors below, the trapezoïdes and the trapezium, the latter taking half the burden. This structure (Fig. 2) is absolutely intermediate between that of the Taxeopoda (Fig. 1) and that of the Diplarthra (Fig. 3), and I imagine that all ungulates, in passing from the taxeopodous to the diplarthrous stages, traversed

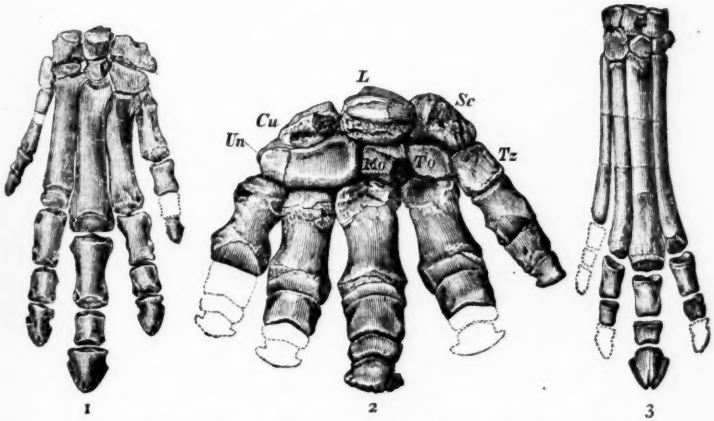


FIG. 1. *Phenacodus primævus*, left manus, one-third natural size. Original.
FIG. 2. *Coryphodon elephantopus*, right fore-foot, one-third natural size. Original.
FIG. 3. *Hyracotherium venticolum*, right fore-foot, two-thirds natural size. Original.

the amblypodous. The only other conceivable path would have been through a type in which the scaphoid had extended over the magnum, while the lunar did not pass outwards beyond the limits of the magnum. No such type has been found. On the other hand, I have shown that the Oredontidæ[1] have pushed the transposition of the bones of the first carpal row to such an extreme that the magnum has gotten entirely under the scaphoid, while the unciform supports the lunar completely. Thus the alternating position, with its useful mechanical consequence, has been lost to this group, the effect produced being exactly that

[1] Proceeds. Amer. Philosoph. Society, 1884, pp. 503–9.

seen in the Amblypoda. This may have had something to do with the extinction of the Oreodontidæ.

The cause of this rotation of the first on the second rows of carpal and tarsal bones may be now referred to. Mammals, except those which are completely plantigrade (as the bear), turn the toes out in walking.[1] In the Ungulata, the toes of the posterior foot are more strongly turned outwards than those of the anterior foot. In the digitigrade Carnivora, which represent the highest type of the Unguiculata, the movement is reversed, the anterior toes being turned outwards more than the posterior. As the foot is descending towards the ground, it is, with the distal part of the leg, rotated from within outwards. The rotation of the foot is promptly arrested at the moment of its contact with the ground, and the effect of this arrest is to produce a torsion of the leg, and a pressure from within outwards of the proximal or moving element of each articulation, against the distal or fixed element. Thus a constant torsion strain from within outwards has been exerted by the first row of carpal and tarsal bones, on the second row, and thus has arisen, as I believe, the gradual transition from the linear arrangement of those bones of the Condylarthra to their alternation seen in the Diplarthra. The advance of diplarthrism is in direct ratio to the advance of digitigradism, for the greater the length of the foot, the greater is the elasticity of the leg, and the greater is the torsion. This is especially true of the posterior leg, with its prominent heel; and thus is explained the fact that diplarthrism appears in that foot before it does in the fore foot, as in the Proboscidia. (Plate XXIX.)

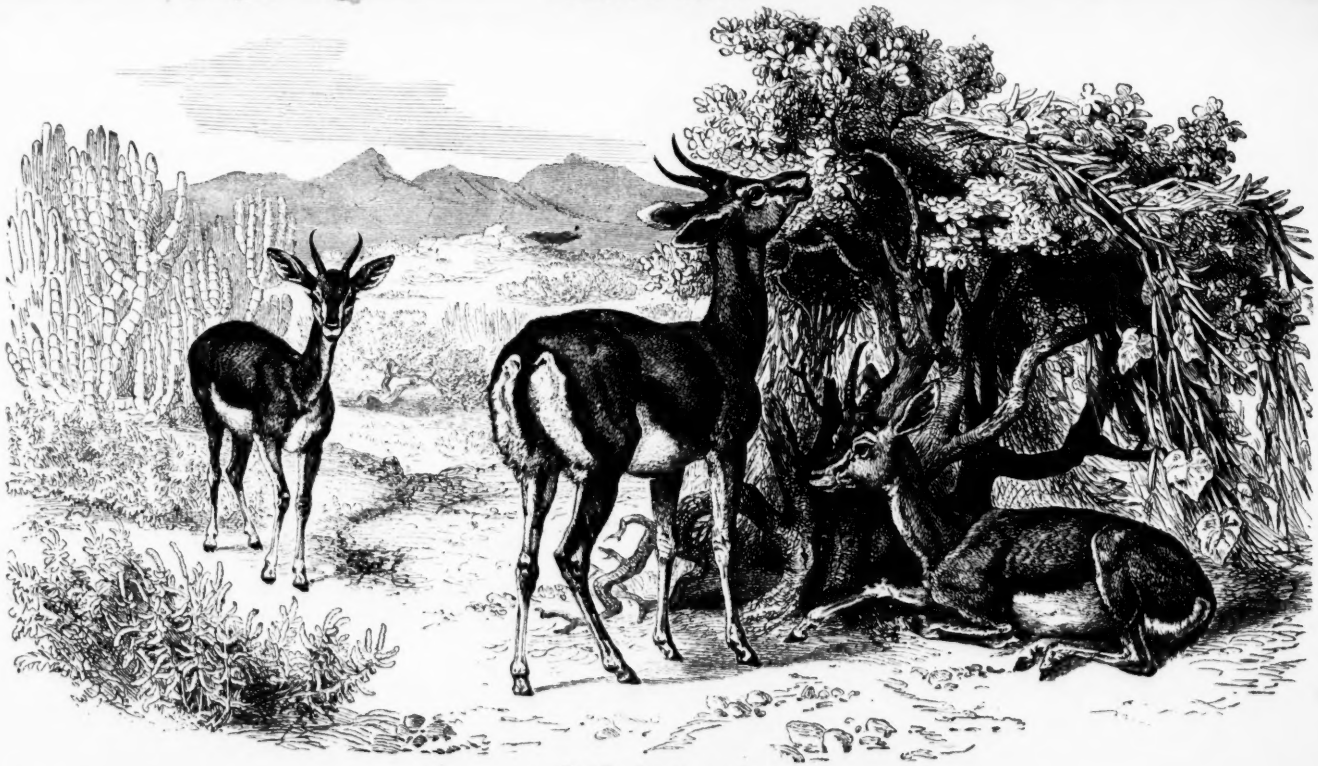
To the same exterior torsion is to be ascribed the early extension of the radius and tibia over the first row of carpals, and the almost exclusion of the ulna and fibula from the articulation.

This reasoning when applied to the Unguiculate series is modified by other circumstances. In the Carnivora the weight of the body does not rest on the ungues as in the Ungulata, but on the pads of connective tissue beneath the digits. Consequently on the application of the foot to the ground the distal bones in the carpal and tarsal articulations do not present the rigid resistance seen in the Ungulata, but yield more or less to the tor-

[1] Familiar exception to this rule is seen in some horses; but the ass turns the toes out, and the tapir, which represents the horse's ancestors, turns the toes out also.

PLATE XXIX.

PLATE XXIX.



Gazella dorcas, gazelle.

(From the Standard Natural History.)

sion. Hence no alternation of these bones takes place in the hind foot of the Carnivora, where the eversion of the digits is moderate. In the case of the fore foot, the eversion and consequent torsion are so great that the alternation is produced (Plate XXVIII.). In the manus of the plantigrade bear the alternation is almost *nil.*

It may be here objected that the camel walks upon elastic pads as do the Carnivora, and yet the alternation does really take place. It is on this account (as I have maintained) that the distal metapodial tongue-keels were never completed in these animals. But if the camel does not rest on the ungues sufficiently to resist torsion, as in the Carnivora, this was not the case in the ancestors of the camels, the Poëbrotheriidæ, where the contact with the ground was much as in other Diplarthra. But there is little impact in the step such as occurs in other Ungulata, hence the failure to complete the keels.

Our zoological gardens furnish excellent opportunities for the verification of all these observations on the progression of Mammalia.

I. Perissodactyla.

The modifications of structure seen in the evolution of this sub-order are principally those of the feet, teeth, and vertebræ. As already remarked, the changes in the feet consist in the gradual reduction of the number of the digits from four, or perhaps five, to one. In the teeth the changes consist in the conversion of tubercular, or bunodont, into crested, or lophodont, molars, and in the increase in the complexity of the premolars, so that, instead of possessing a distinct and simple character of their own, they come to resemble the true molars; also in the reduction in the dimensions and numbers of the canine and incisor teeth in some lines. The modification of the vertebræ consists in the conversion of a flat zygapophysial articulation into a concavo-convex or embracing structure. This modification is similar to what is seen in some of the Artiodactyla, but the change is carried further, and the structure becomes more complex in the latter suborder.[1] In the teeth the change pursues two paths, both different from that seen in the Artiodactyla. The modifi-

[1] See "Systematic Arrangement and Phylogeny of Artiodactyla," in Proceeds. Amer. Philos. Society, September, 1887.

cation of the feet is of a different type, as already stated in the definitions of the two orders.

The first step in dental modification in the superior series is the flattening of the external tubercles, and their connection with each other at the base. The beginning of this process is seen in *Heptodon singularis* (Fig. 4) and its allies of the Hyracotheriinæ.[1] A concomitant change is the confluence of the internal cusps with the intermediate ones into crests or ridges, which may be transverse or oblique (Figs. 4, 12, and 15), or may be otherwise varied, as in the equine line. In the lower jaw two lines of change have developed. In the one the tubercles of the crown have been opposite, and have become joined in pairs by transverse ridges or crests (Fig. 12); while in the other the cusps have become alternate, so that the ridges which joined them have been oblique, each tubercle giving origin to two crests extending in divergent directions,—that is, to the cusps with which it alternates. The result has been a W-shaped crest or line of crests (Figs. 26 *b*, 28).

FIG. 4. Part of right maxillary bone of *Heptodon singularis* Cope; from the Wasatch beds of New Mexico. From Captain Wheeler's report, iv., ii. Pl. LXVI.

Ryder has pointed out that the rhinoceros masticates its food by the movement of the mandibular ramus from without inwards on the upper jaw. The same is true of the species of Equus (*E. montanus*, *E. asinus*, *E. caballus*). The same author points out that the masticatory movement in the selenodont Artiodactyla is in the opposite direction, from within outwards.[2] It appears to me probable that many of the primitive Perissodactyla had the same movement as the latter. They, however, present a remarkable difference from the selenodont Artiodactyla in another respect. The mandibular condyle in Hyracotherium,

[1] These are frequently accompanied by an additional external cusp, which springs from the anterior external angle of the crown. (See Figs. 4, 8, 10)

[2] Proceedings Academy Philada., 1878, p. 45. Although Professor Ryder afterwards gave up this view, and concluded that the Artiodactyla had the same movement as in the Rhinoceros (l. c., 1879, 47), his first opinion was undoubtedly the correct one.

Symborodon, etc., is strongly convex upwards, so that a lateral twist of the entire lower jaw in mastication becomes possible. The result of this has been to throw the masticating function almost entirely on the external cusps of the molars in both jaws. Thus is explained the fact that in this order the external cusps of the molars in both jaws only are modified, while the internal remain of relatively small dimensions, and often primitive form. In the tapir, where the movement in mastication is almost vertical, neither set of tubercles attains a remarkable specialization.

For the three modes of mastication mentioned the following terms are proposed: Vertical movement (Carnivora, Bunodonta), Orthal; from within outwards, Ental; from without inwards, Ectal (from ἀλετν, to grind).

The three lines which originated from the Lophiodontidæ are those which terminated in the Equidæ, the Tapiridæ, and the Rhinocerontidæ. They differ in the characters of the superior molar teeth as below pointed out. The mechanical cause of these peculiarities is not far to seek. In the Equine line mastication has been effected on that side of the mouth where the lower jaw, in its transverse motion across the superior molars, was moving from the inside outwards, as in the selenodont Artiodactyla (ruminants). In the Tapiroid line there has been little transverse movement of the lower jaw, so that V's have not been developed in the molars of either series. In the Rhinocerontine line mastication has been performed on that side of the mouth where the lower jaw was passing from the outside inwards. This is the method of mastication of the Rhinoceros to-day, as observed by Professor Ryder.[1] The effects of these distinct kinds of mastication are seen in different forms of the external walls of the superior molars. In the Equine line (Chalicotheriidæ, Menodontidæ, and Palæotheriidæ) the edges of the external cusps have been drawn externally by the ental movement of the lower jaw, thus producing the legs of the two V's. In the Rhinocerontine line the branches of the single large anterior V have

[1] Proceeds. Academy Philadelphia, 1879, p. 49. In this paper Professor Ryder recedes from his position that the V's of the selenodont superior molar have been produced by the ental movement, and endeavors to demonstrate that they have arisen by pressure on the cusps by an ectal movement. This view is negatived by the fact that it is not the apices of the cusps which are engaged in primitive mastication, but their sides and lateral ridges. The former fall between the cusps of the opposite jaw.

been drawn inwards by the ectal movement of the lower jaw, so that the external wall slopes inwards at the point where it forms in the horse line a V with the angle outwards. In some of the genera (as Isectolophus) a median, inwardly-directed V is developed at this point. The posterior end of the wall is turned a little outwards in some forms of this series, but this is due to a return or ental movement of the lower molar, of short duration, which has also drawn out externally the external end of the anterior cingulum. The two lines of development are also indicated in the lower molars. The one has V's on the lower molars, and the other has cross-crests. The development of V's is due to the development of intermediate tubercles of the superior molars. These cause the crown of the inferior molar to pursue a curved path across the upper, so that when the external cusp of the inferior molar is deflected forwards by the intermediate cusp of the superior, the inner cusp of the former must alternate with the external of the same, in order to pass between the internal cusps of the superior molar.[1]

With these preliminary remarks, I give the following synopsis of the families:[2]

I. No Λ-shaped space with the apex external between cusps of superior molars. Inferior molars with cross-crests.
  A. Premolars different from molars.
  a. Superior canine teeth present.
  1. Toes 4–3; ..... *Lophiodontidæ*.
  2. Toes 3–3; ..... *Triplopodidæ*.
  aa. No superior canine teeth.
  3. Mastoid bone not exposed in external wall of skull; ..... *Cænopodidæ*.
  AA. Superior molars and premolars alike, with cross-crests.
  a. External cusps of superior molars fused into a wall.
  4. Mastoid bone forming part of the external wall of the skull; superior canines present; ..... *Hyracodontidæ*.
  5. Mastoid bone excluded from the walls of the skull by the contact of the occipital and squamosal; no superior canines; ... *Rhinoceridæ*.
  aa. Exterior cusps of superior molars subequal, distinct.
  6. Superior molars and premolars alike, and with cross-crests; toes 4–3; ..... *Tapiridæ*.

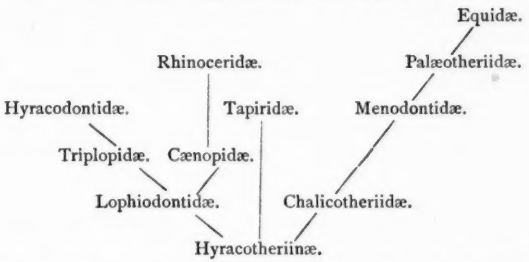
II. The external cusps of the superior molars subequal, separated by an Λ-shaped space, with the apex external; inferior molars with crescents.
  A. Superior premolars different from molars; with only one internal cusp.
  7. Toes 4–3; a vertebrarterial canal; ..... *Chalicotheriidæ*.

[1] These relations will be more fully discussed and illustrated in an article shortly to appear.

[2] Modified from that published in the Proceeds. Amer. Philos. Soc., 1881, p. 378.

8. Toes 3–3; no vertebrarterial canal;.....*Macraucheniidæ.*
AA. Premolars like molars, with two internal lobes above.
9. Toes with digits 4–3;.....*Menodontidæ.*
10. Toes with digits 3–3;.....*Palæotheriidæ.*
11. Toes with digits 1–1;.....*Equidæ.*

The total number of well-determined species of this order is about two hundred. It was abundantly represented during the Eocene period, and the recent species are comparatively few. It may be also observed that certain families predominated during certain periods. Thus the prevalent *Perissodactyla* of the Eocene are *Lophiodontidæ* and *Chalicotheriidæ;* those of the Miocene are *Rhinocerontidæ* and *Palæotheriidæ.* The *Tapiridæ* and *Equidæ* characterize the latest tertiary epochs. A genealogical tree of the order may be constructed as follows:



The leading types of the order, divisions I. and II., differ only in the two points of the separation or non-separation of the exterior cusps of the superior molars by a V-shaped interspace, and the transverse or oblique crests of the inferior molars. That no great modification of known forms (as *Lambdotherium* in the *Chalicotheriidæ*, and *Hyracotherium* in the *Lophidontidæ*) would be necessary to obliterate this difference is quite clear. How readily the transverse-crested lower molar can be modified into the V-bearing type may be seen by comparing the inferior molars of *Hyracotherium* with those of a rhinoceros.

The LOPHIODONTIDÆ includes a larger number of known species than any of the others of the order. With one exception, all the species belong to the Eocene period. They range from the size of a rabbit to that of an ox. They resembled most, among living animals, the tapirs.

The genera are characterized as follows:

I. External lobes of superior molars well separated and little flattened; lobes of inferior molars scarcely united (*Hyracotheriinæ*).

A. No diastemata.
a. Fourth inferior premolar unlike the first true molar.
Last inferior molar with five lobes; superior premolars four;..... .....*Systemodon* Cope.
AA. A diastema behind the first premolar in both jaws.
a. Last inferior premolar different from first true molar.
Last inferior molar with heel; cross-crests of superior molars interrupted;.....*Hyracotherium* Owen.
aa. Last inferior premolar like first true molar.
Dentition generally as in Hyracotherium.....*Pliolophus* Owen.

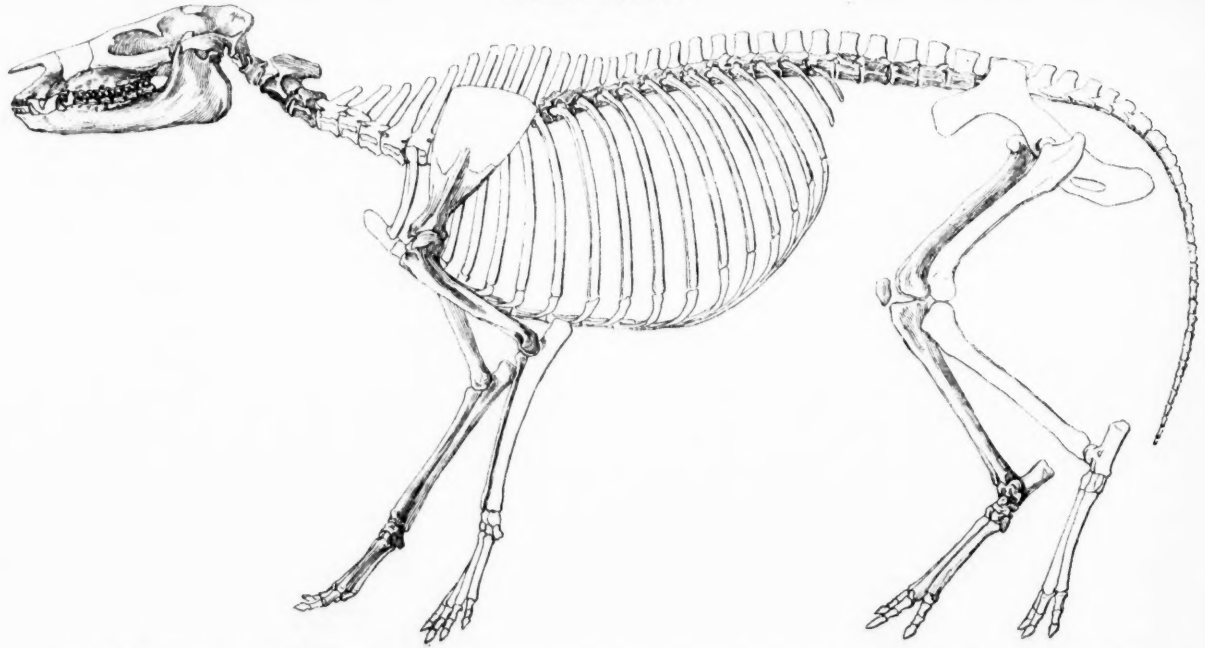
II. External lobes of superior molars well separated and little flattened; inferior molars with perfect cross-crests (*Protapirinæ*).
Last inferior molar with heel; ? four premolars;.....*Isectolophus* S. and O.
Last inferior molar without heel; inferior premolars three;..*Protapirus* Filh.

III. External lobes of superior molars flat, not well distinguished, forming a wall. Inferior molars with perfect cross-crests (*Lophiodontinæ*).
"A. No diastema in lower jaw.
Last inferior molar with third lobe;.....*Helaletes*" Marsh.
AA. Lower jaw with diastema.
* No diastema behind first premolar.
a. No inferior premolars like the true molars.
Superior molars 7.
Last inferior molar with heel;.....*Heptodon* Cope.
Last inferior molar without heel;.....*Hyrachyus* Leidy.
Superior molars 6.
Last inferior molar with heel;.....*Lophiodon* Cuv.
Last lower molar without heels, no horns;.....*Dilophodon* Scott.
Last lower molar?; "an attachment for a dermal horn on each nasal bone;".....*Colonoceras* Marsh.

The above table shows that the modification which this family has undergone in its superior molars, has consisted in the confluence of the external tubercles into a more or less irregular external wall to the crown, and the confluence of the intermediate and internal tubercles into cross-crests. In the lower molars cross-crests have been formed. It is impossible to separate the Hyracotheriine sub-family as a family from the Lophiodontine, since the characters grade into each other completely. But it has been from the Hyracotheriine sub-family that the horse line was derived; the Protapirinæ gave origin to the Tapiridæ; while the rhinoceroses have descended from the Lophiodontinæ.

Among Hyracotheriinæ the genus Systemodon (Cope) holds the lowest place on account of the entire absence of diastemata from the dental series. It is as old as any of the genera, occur-

PLATE XXX.



Hyracotherium venticolum, Cope, skeleton restored, one-third natural size; from the Wasatch beds of Wyoming, N. A. Original except ribs, which are after Osborn. Unshaded portions not preserved in specimen, which is in Coll. E. D. Cope.

ring in the Wasatch (or Suessonian) epoch. A common ancestor gave origin to Systemodon and Hyracotherium. It resembled the former in the absence of diastemata, and the latter in the

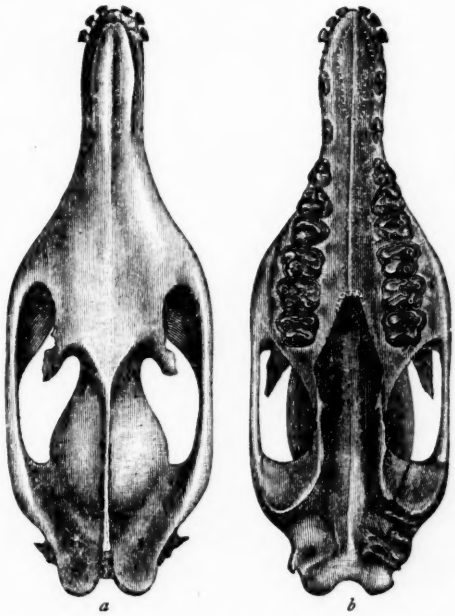
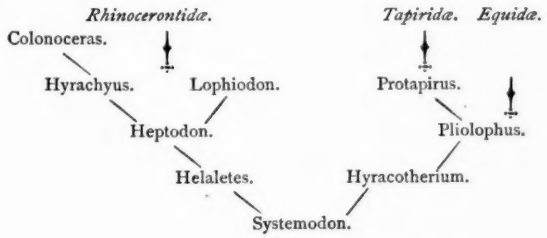


FIG. 5. Skull of *Hyracotherium venticolum* Cope, three-quarters natural size; from Wind River Eocene of Wyoming. Original. Fig. *a* from above; *b* from below.

greater distinctness of the cusps of its molars. The succession of the genera may be represented somewhat as follows:



In the Lophiodontine line we have Helaletes (Marsh) without diastema, like Systemodon. In Heptodon the diastema appears,

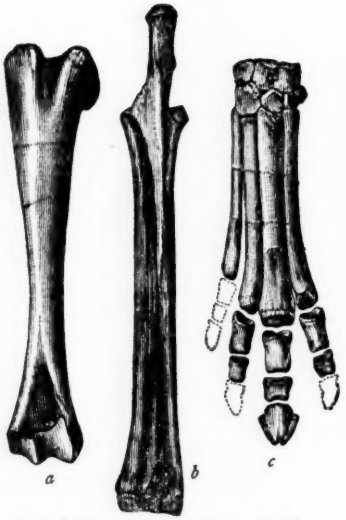


FIG. 6. Fore-leg and foot of *Hyracotherium venticolum* Cope, two-thirds natural size; from Eocene beds of Wind River, Wyoming. Original, from "Report U. S. Geol. Surv. Terrs.," iii. Fig. *a*, humerus from front; *b*, ulna and radius from behind; *c*, anterior foot from before.

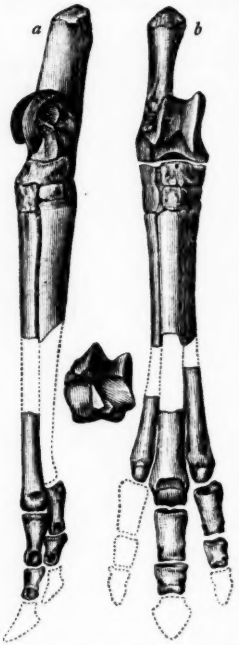


FIG. 7. Posterior foot of specimen of *Hyracotherium venticolum* already figured; *a*, left side; *b*, from front; *c*, distal end of astragalus and calcaneum.

and in the succeeding genera the first premolars are lost. In Hyrachyus the heel of the last inferior molar vanishes, while the nasal bones bear traces of dermal horns in Colonoceras (Marsh). The transition from Hyrachyus to the Rhinocerontid series is not difficult. The nearest form is Cænopus of the Cænopodidæ, which only differs from Hyrachyus in the lack of the canine teeth above, and of the middle incisors. The passage to the Tapiridæ is equally easy, through the close resemblance of Protapirus (Filh.) to Tapiravus (Marsh) of the

latter family. The latter only differs from the former in the increased complexity of the premolars. The passage to the horse line is suggested by the resemblance of Pliolophus

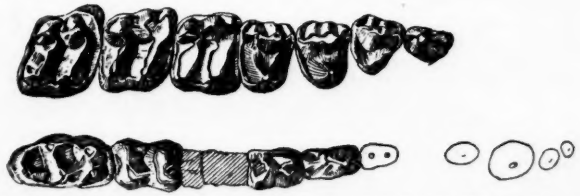


FIG. 8. *Systemodon tapirinus* Cope, dentition; upper figure, right superior molars from below; lower figure, left inferior molars from above; natural size. Original; from Wasatch bed of Wyoming.

FIG. 9. *Heptodon ventorum* Cope, superior molars of left side, natural size. Original; from Wind River beds of Wyoming. From "Report U. S. Geol. Surv. Terrs.," F. V. Hayden, vol. iii.

(= Orohippus Marsh) to Anchitherium of the family of the Palæotheriidæ. The transition is seen in some genera of the intermediate family of the Chalicotheriidæ, beginning with Ectocium (Cope).

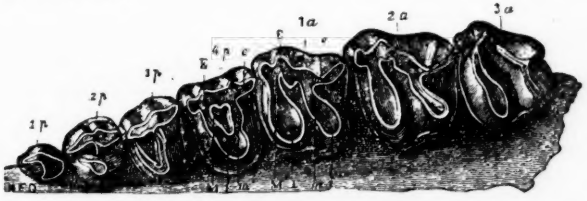


FIG. 10. *Hyrachyus agrarius* Leidy, superior molar teeth, natural size; from Bridger bed of Wyoming. From Leidy, "Report U. S. Geol. Surv. Terrs.," F. V. Hayden, vol. i.

Three species of Systemodon are known, all from the Wasatch Eocene. The largest, *S. tapirinus* Cope, was equal to a large ram. A dozen species of Hyracotherium are known from the Eocene of Europe and North America, which range in size

from that of a sheep to that of a kit-fox. Several species of Helaletes have been described from the Bridger Eocene. The species of Hyrachyus are rather numerous, and range through

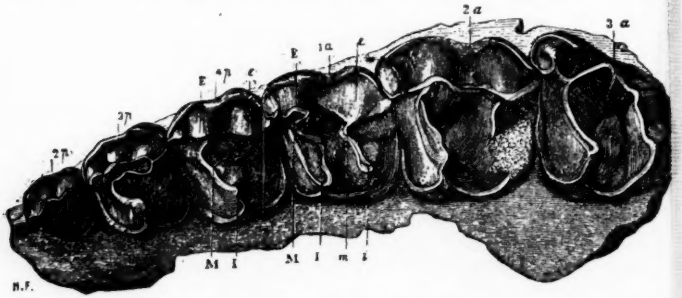


FIG. 11. *Lophiodon isselensis*, superior molars three-fifths natural size; from Middle Eocene of France. From Gaudry, "Enchainements du Régne Animal."

the Wind River, Bridger, and Diplacodon beds. Dilophodon has two species and Colonoceras one species, in the Bridger. Lophiodon is, so far as yet known, confined to Europe. One of its species, *L. rhinoceroides*, was as large as a medium-sized rhinoceros, and several species ranged in dimensions to those of a sheep. They appear in the Bruxellian, and range upwards through the Bartonian. Heptodon is, so far, only American; two species, a large and a small, are found in the Wasatch formation, and two, of intermediate size, in the Wind River.

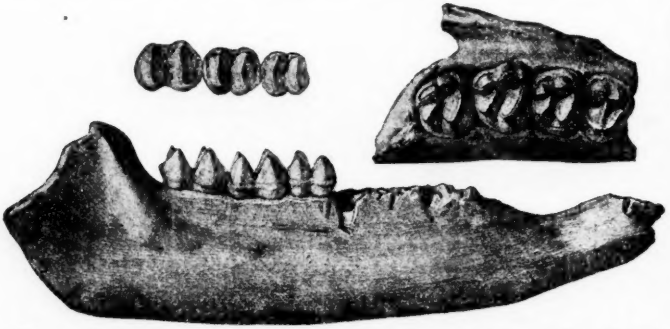
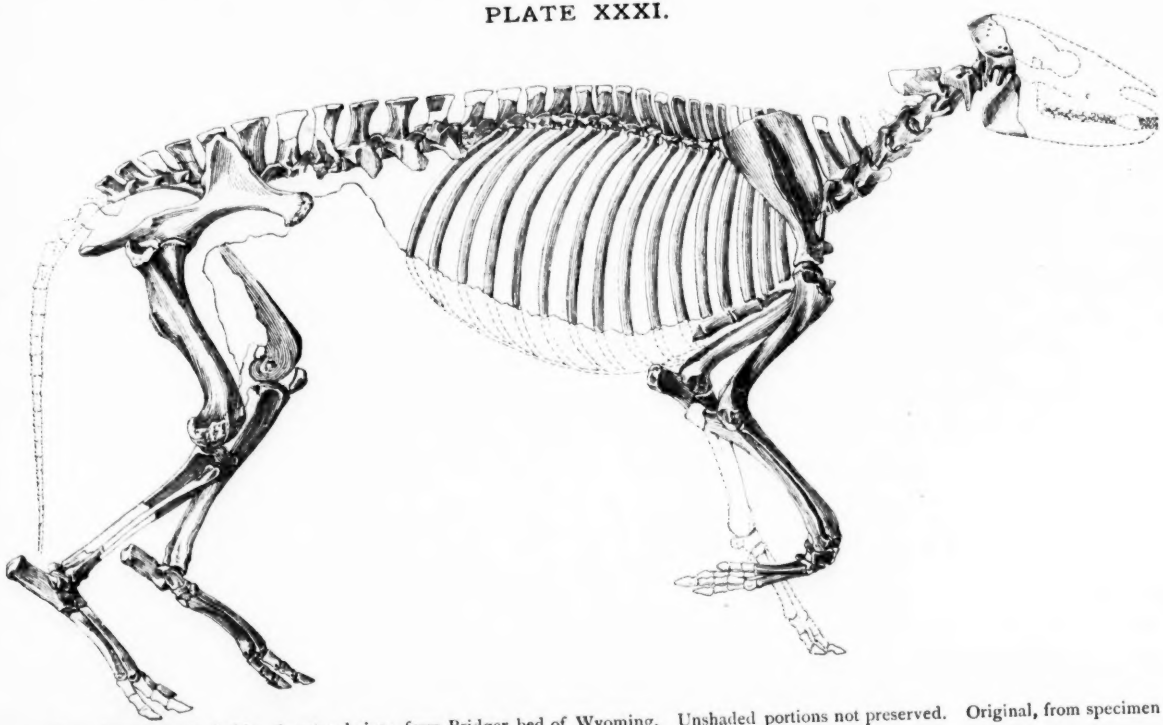


FIG. 12. *Protapirus priscus* Filh., Phosporites of Quercy, France, three-fourths natural size. From Filhol.

Protapirus is from the Phosphorites of France; and Isecto-

PLATE XXXI.



Hyrachyus agrestis, Leidy, $\frac{2}{15}$ natural size; from Bridger bed of Wyoming. Unshaded portions not preserved. Original, from specimen in Coll. E. D. Cope.

lophus is from the summit of the Eocene in North America, or from the Diplacodon beds.

As but one genus of TRIPLOPODIDÆ is known, its origin and probable descendants only can be referred to. It may very readily have been derived from Heptodon, with which it agrees in dental formula. The loss of the heel of the last inferior molar and of the fifth anterior digit would metamorphose Heptodon into Triplopus. Two species are known, both from the upper division of the Bridger Eocene. A possible third species is from the Diplacodon bed (*Prothyracodon* S. and O.).

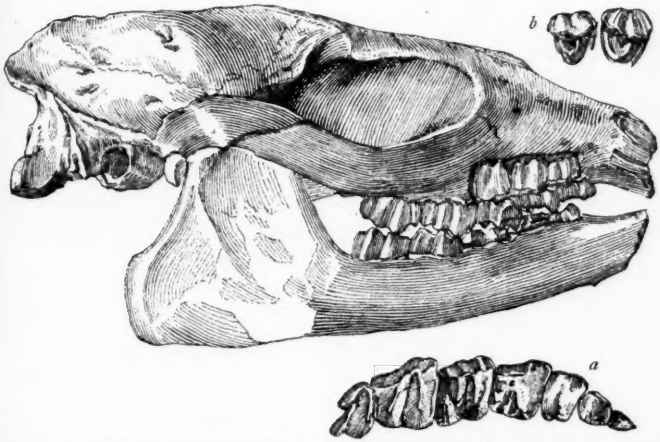


FIG. 13. Skull of *Triplopus cubitalis* Cope, from the Bridger Eocene of Wyoming, three-quarters natural size; right side. Original; from the "Report U. S. Geol. Surv. Terrs.," vol. iii. Fig. *a*, superior molars with deciduous premolars; *b*, third and fourth superior premolars.

The CÆNOPIDÆ include genera which have lost the superior canine teeth, and have thus come to resemble the rhinoceroses. The known genera resemble these animals also in the reduction in the number of the incisors, and in one genus at least a dermal horn was present. The two genera known differ as follows:

No dermal horn;.....*Cænopus* Cope.
A dermal frontal horn;.....*Dihoplus* Brandt.

This family constitutes the transition between the Lophiodontine group of the Lophiodontidæ by Heptodon or Hyrachyus,

and the Rhinocerontidæ. Cænopus embraces, as yet, only American species, of moderate and small size; the *C. occidentalis* Leidy had four toes in front and three behind, representing the type which is the phylogenetic ancestor of the lowest and only four-fingered genus of Rhinocerontidæ, Aceratherium. A cusp is sometimes present within the inner extremity of the incurved, transverse crest of the premolars in Cænopus. Fusion of this with the transverse crest has produced the double transverse crests of the premolars of the Rhinocerontidæ. Dihoplus must be regarded as a collateral outgrowth from Cænopus. It is represented by one European species, the *D. schleiermacheri*, which is of larger size than either of the known species of Cænopus.

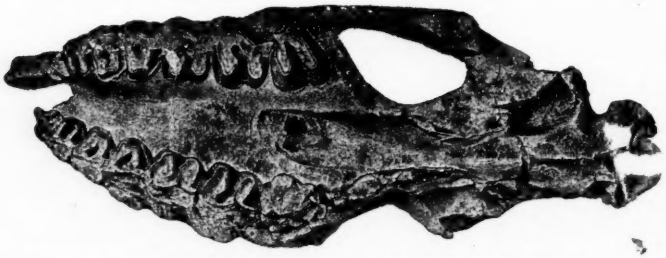


FIG. 14. *Cænopus occidentalis* Leidy; cranium, one-fourth natural size, from below; from the White River Miocene of Nebraska. From Leidy, "Ancient Fauna of Nebraska."

In the HYRACODONTIDÆ we have a direct descendant from the Lophiodontidæ, but presenting a modification quite different from the Cænopidæ. In that family the canines were lost and the simple premolars retained; in the present family the canines are retained and the premolars become complex, as in the rhinoceroses. Three, perhaps four, genera are known:

I. Canines very distinct from incisors.
  Premolars $\frac{4}{4}$;.....*Amynodon* Marsh.
  Premolars $\frac{3}{3}$;.....*Metamynodon* S. and O.

II. Canines small, similar to incisors.
  Premolars $\frac{4}{4}$;.....*Hyracodon* Leidy.

These genera are all hornless.

Amynodon is the oldest and ancestral genus; its two species belong, one in the Diplacodon formation, and the other in the Bridger. Desmatotherium (Scott) belongs here, but I do not

know how to separate it from Amynodon. Metamynodon and Hyracodon are from the White River Miocene. The family is not yet known from higher formations, and appears to have died out. Why such a robust and well-defended type as Metamynodon should have disappeared, and the comparatively weak and entirely unarmed Cænopus should have survived, is not easy to understand. In Hyracodon we observe a degeneracy of the anterior dentition of both jaws. According to Scott, *Hyracodon nebrascensis* was "a slender, long-limbed, and slightly-built animal, with a long neck." Three or four species only are known. The entire family is, so far, only known from North America. The phylogeny may be thus represented:

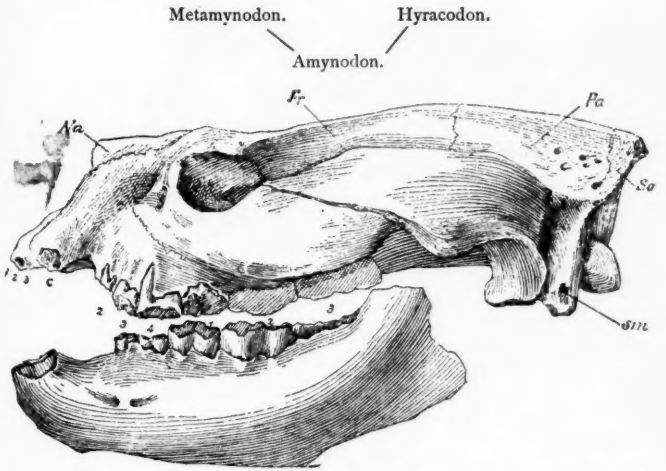


FIG. 15. *Metamynodon planifrons* S. and O.; skull, one-sixth natural size; left side. From Scott and Osborn, in "Bulletin of Mus. Compar. Zoölogy Cambridge."

The RHINOCERONTIDÆ came into existence in the Miocene of Europe, in a genus nearer to the Cænopidæ than any other of the family. This approximation is shown in the persistence of the external or fifth digit of the anterior foot in the genus Aceratherium (Kaup.). In this form all the superior premolars have the structure of the true molars; so that it enters the present family. The general relation of the component parts of the true molars in the rhinoceros family is that of the Lophiodontidæ in all important respects. The external ends of the cross-

crests of the inferior true molars are generally turned forwards and inwards, showing a tendency to the formation of V's.

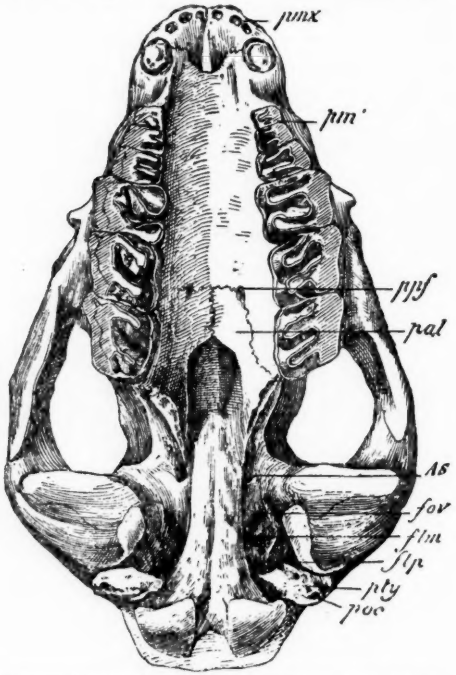


FIG. 16. *Metamynodon planifrons* S. and O.; the same cranium from below; from White River bed of Nebraska. From Scott and Osborn, in "Bulletin of Mus. Compar. Zoölogy Cambridge."

The changes in the structure of the genera of this family are seen in the loss of incisor teeth, of the fifth digit from the anterior foot, and in the greater co-ossification of various bones of the skull,—among them of the nasal bones,—to support the offensive dermal horns. In Cœlodonta and Elasmotherium the nasal bones are further supported by the ossified nasal septum, and the last-named genus adds an osseous basis or even core for a horn on the frontal bone. In most of the genera the cross-crests of the superior molars are comparatively simple, but in Atelodus and Cœlodonta they display projecting angles, which, on wearing, join each other. In this way the valleys become surrounded or enclosed. This is especially the case

with the extinct genera of the Old World, Cœlodonta and Elasmotherium. In the latter the molars became prismatic, and the vertical enamel-plates vertically plicate.

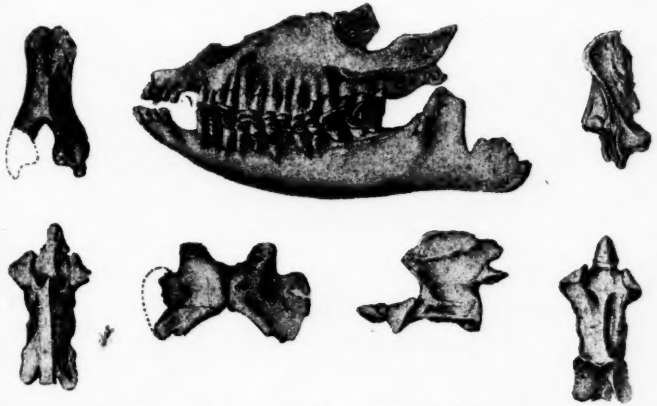


FIG. 17. *Hyracodon nebrascensis* Leidy, cranium, four-fifteenths natural size; left side of facial region and lower jaw; occipital and mastoid regions from behind and from side; and atlas and axis, the latter from above, side, and below; from White River Miocene of Colorado. Original.

This line first appears in Europe, and in Europe, Asia, and Africa it reached its highest specialization and force, in two lines. The one terminated in the genus Rhinocerus, of which two species now exist in Asia. The other line first appeared in the upper Miocene of Europe and India, in the genus Atelodus, of which two species still exist in Africa. From this the genus Cœlodonta took its origin, and peopled the temperate and cold regions of Europe and Asia. This form gave rise to Elasmotherium, which was the largest and most remarkable of all the Rhinocerotidæ. Its only known species, *E. typum*, dwelt in the cold regions of Europe and Asia.

In North America it developed only two genera, Aphelops[1] and Diceratherium, the former in the Loup Fork, the latter in the John Day, Miocene ages. Both were numerous in individuals. Aphelops did not develop a horn. Diceratherium developed two opposite tuberosities on the nasal bones, which probably supported dermal callosities.

[1] For an illustrated account of this genus, see NATURALIST, 1879, p. 771, *a*.

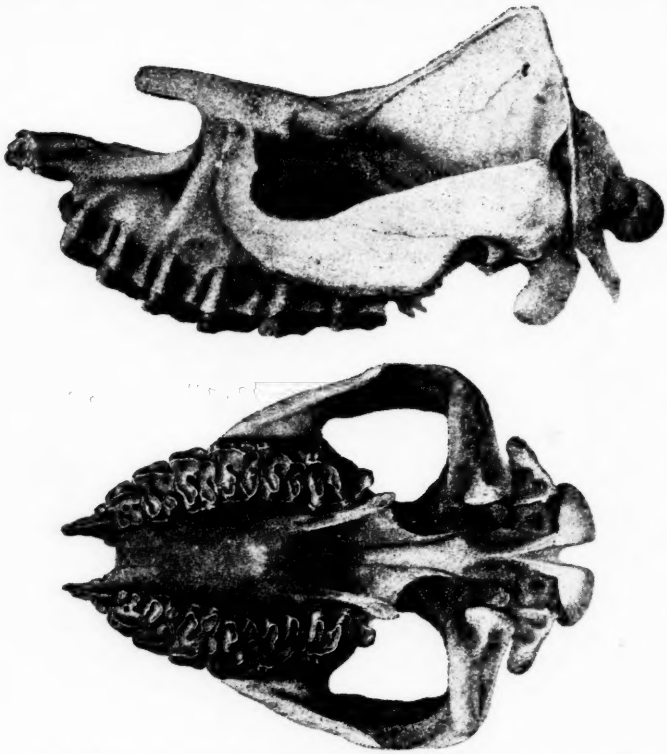


FIG. 18. *Peraceras superciliosus* Cope, about one-sixth natural size; from Loup Fork bed of Nebraska. Original. Fig. *a*, left side; *b*, from below.

A. Four anterior digits.

Incisors $\frac{2}{1}$; canine $\frac{0}{1}$; no horn; posttympanic bone distinct;...*Aceratherium* Kaup.

AA. Three anterior digits.

a. Posttympanic process not coossified with postglenoid.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; no dermal horn; .....*Aphelops* Cope.

Incisors $\frac{0}{1}$; canines $\frac{0}{1}$; no dermal horn; .....*Peraceras* Cope.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a tuberosity for a dermal thickening on each nasal bone;.....*Diceratherium* Marsh.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a median dermal nasal horn;.....*Ceratorhinus* Gray.

Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; dermal horn median; no osseous nasal septum;.....*Atelodus* Pomel.

aa. Posttympanic process coossified with postglenoid;

β. No median frontal horn-core.

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; dermal horn median; nasal septum not ossified;.....*Rhinocerus* Linn.

Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; dermal horn median; nasal septum ossified;..... .....*Cœlodonta* Bronn.

$\beta\beta$. A frontal median horn-core.

Molars prismatic;.....*Elasmotherium* Cuv.

FIG. 19. *Atelodus pachygnathus* Wagn., left tarsus, one-fourth natural size, showing three posterior digits; from the Upper Miocene of Greece. From Gaudry.

FIG. 20. *Aceratherium tetradactylum* Lart., anterior foot minus the first row of carpal bones, one-fourth natural size, front; from Miocene of Sansan, France. After Gaudry; in Les Enchainements du Régne Animal.

The phylogeny of the rhinoceroses may be represented as follows:

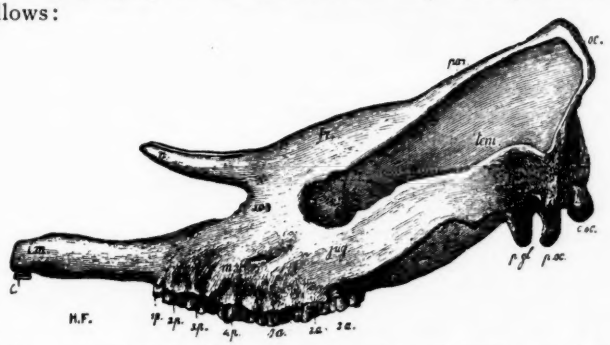


FIG. 21. *Aceratherium incisivum* Cuv., skull, one-seventh natural size; from the Miocene of Epplesheim, Germany. From Gaudry, after Kaup.

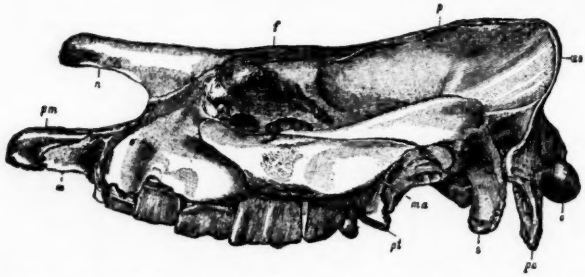
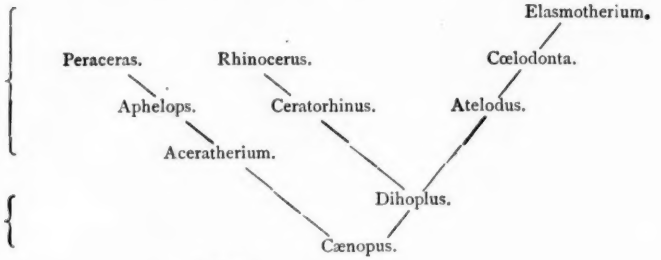


FIG. 22. *Aphelops fossiger* Cope, skull, one-fifth natural size, from side and below; from Loup Fork beds of Kansas. From Marsh.



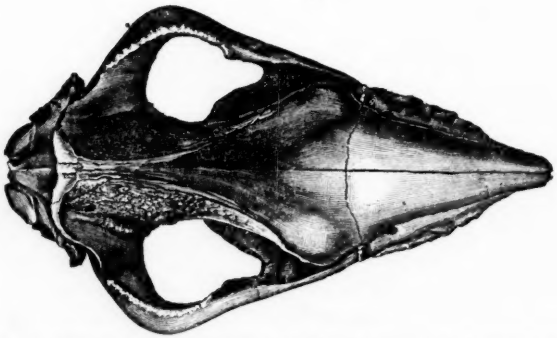


FIG. 23. *Aphelops megalodus* Cope, skull from above, one-sixth natural size. From the Loup Fork bed of Colorado; original.

The history of the TAPIRIDÆ has been mainly unravelled by Scott. Their origin from the Protapirine division of the Hyracotheriinæ cannot be doubted, but the intermediate forms have been mostly lost. The oldest genus appears in the Lower Miocene of North America (White River), and it is followed by

Tapiravus (Marsh) of the Upper Miocene. Tapirus is first found in the Upper Miocene of Germany (Epplesheim). The recent species of the family belong to Tapirus L., and Elasmognathus (Gill).

The three genera are distinguished as follows:

Two superior premolars different from true molars;.. *Tapiravus* Marsh.
One superior premolar different from true molars;
no heel of third inferior molar; nasal septum
cartilaginous;..... *Tapirus* L.
Like *Tapirus*, but nasal septum osseous;..... *Elasmognathus* Gill.

The order in which these genera stand above, represents their phylogenetic as well as their taxonomic relations, the oldest genus standing first.

(To be concluded.)

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

To discover the relation of mind to matter is the goal of scientific research, and every addition to knowledge may be regarded as a contribution to this subject. The advent of Neo-Lamarkianism brings the question immediately within the view of the student of natural history, where it belongs, and brings it out of the metaphysical limbo, where it has so long lain neglected by science. The evidence that the environment is not the only factor in evolution is abundant enough, and the attempt to restrict the remaining factors to "heredity" has not long satisfied the mind of science. The evidence that the movements of animal organs and tissues is the other factor, constituting the source of heredity, is becoming clearer and clearer. The relation of sensation (consciousness or mind) to motion, is supposed to be well known, so that the direct dependence of evolution on the former seems to be an inference fully justified by the knowledge now in our possession.

But every step in this logical succession is, and ought to be, contested. It is denied by some that animal movements do materially affect animal structures. It is further denied that such

modifications if produced can be inherited. Since, however, it is admitted that mechanically-profitable variations do appear, and that they are inherited, the inquiry at this point is limited to the question whether the impacts, strains, torsions, flexures, etc., to which the parts of an animal are subjected by its motions do affect the structure or not. The final contest is, however, of a remarkable character. It is denied that the mental condition of an animal—*i.e.*, its sensations—has any influence in the determination of its movements. This proposition is apparently equivalent to the assertion that designed movements do not exist. An animal does not eat because it is hungry; it does not seek flight because it is frightened; it does not seek shelter because of temperature or storm; its voice is exerted without purpose, etc., etc. We imagine that it will be long before such an opinion can be sustained by any scientific evidence. Yet it seems to be the only alternative that is open to those who deny that consciousness is at the basis of evolution. It would seem to be the final *reductio ad absurdum* of that side of the question.

A brief statement of a discussion of these points referred to in the last NATURALIST is deferred to the December number, general notes, department Psychology.

THE appearance of the first number of Dr. Whitman's *Journal of Morphology* seems an event of sufficient importance in the history of American science to warrant more than a mere announcement. Several times have magazines been started which were fondly expected to play the same part in the United States that the *Quarterly Journal of Microscopical Science* does in England, but all have lamentably failed. Their editors have not succeeded in gaining the confidence and support of the best American workers. This rock Dr. Whitman has apparently escaped, and his first number, in variety of subject and breadth of treatment as well as in beautiful appearance, will compare favorably with any publication in the old world.

RECENT LITERATURE.

The Origin of the North American Flora.—The fifteenth report of the State Geologist of Indiana, issued in March of the present year, contains a long article on the "Origin of the Indiana Flora," by John M. Coulter and Harvey Thompson. The second part of the article, beginning on page 265, is on the "Origin of the North American Flora." It is so similar in many respects to an article published by myself in the *Journal of the Cincinnati Society of Natural History* in 1881, vol. iv., that I desire to call attention to it. I have arranged in parallel columns the parallel passages. The pages are those on which the similar passages are found. My article is entitled "On the Geographical Distribution of Plants Common to Europe and the Northeast United States."

Coulter and Thompson.

"In studying the flora of North America one cannot help being impressed with the fact of the identity of many of our genera, and even species, with those of Europe, and especially of Eastern Asia. In the number of identical species there seems to be a closer resemblance between the floras of Eastern United States and Eastern Asia than between the floras of the Eastern United States and the Pacific slope." P. 265.

"In addition to these 342 distinct species, [referring to a printed list which contains only 328 names] there are in our flora many varieties which are indigenous to Europe, and in Europe varieties very close to some in this country. Also there are many species in this country so very near European forms that no doubt they will eventually be considered the same species, or at least varieties. Indeed, Joseph F. James supposes that one-third of the species found in Gray's Manual resemble forms in Europe. When we take into consideration the fact that the Manual covers only a very small portion of North America, it is a natural inference that when the whole flora of North America is compared with that of Europe, there will be found many other species common to both." P. 269.

"It would be easy to account for this wide distribution of species if there were not so many facts to disprove the theory advanced by Meyen in 1846, that 'there is indeed nothing more easy to perceive, in the distribution of organic beings over the globe, than the universal law, that

James.

"Prof. Gray has made it well known that there is far more resemblance between the plants of the Atlantic coast of the United States and the Pacific coast of Asia than between the latter and the Pacific coast of America, especially of California." P. 67.

"The resemblance between the floras of Europe and the United States is by no means confined to the 360 identical species [given in several lists]. There are, besides, many closely related species, some of which may be reduced to geographical varieties. . . . If to the identical species we add these related and representative species, we shall find that one-third of the 2277 indigenous species given in Gray's Manual resemble European forms. But the similarity between the floras of North America and Europe is by no means confined to the small territory with which I have been dealing [the Northeastern United States]. . . . I have no doubt but that a comparison of the entire flora of the United States (excluding the semi-tropical one of California . . .) will show nearly as much resemblance as I have shown exists in the small territory here dealt with." P. 66.

"Scarcely any one now believes in the assertion of an eminent authority,* that 'there is indeed nothing more easy to perceive, in the distribution of organic beings over the globe,'" etc., etc. P. 51.

"* Meyen, Geog. of Plants. Pub. of Roy. Society, 1846, p. 265."

Coulter and Thompson.

nature, in similar circumstances, has always produced similar or perfectly the same creatures.'" P. 270.

. . . "We find the scientific thought of the day to be, as expressed by Alfred Wallace, that 'every species has come into existence, coincident both in space and time with a pre-existing, closely-allied species.'" P. 270.

"'Therefore, when we find identical species in two different quarters of the globe, we believe the individuals in both localities to be descended from a common parent.'" P. 271. [Quoted without reference.]

"Naturally we look to the north for this highway between the two continents [Europe and America]; for there is now very close connection with Asia on the northwest. . . . However, having evidence of former land elevation in high latitudes, or accepting Croll's theory in regard to the displacement of the earth's centre by a polar ice-cap, which would result in the ocean having a lower level in these latitudes in the Tertiary period than now, in either event the continental masses would be nearer together at that time, if not in actual connection." P. 271.

"As yet much of the region in the vicinity of the North Pole is unknown, but enough has been discovered to prove that there is much land within a short radius of the Pole." P. 271.

"Along with these forest-trees [sequoia, tulip, etc.] which have been preserved must have grown the shrubs and herbs which we now find coexisting with them in temperate climes." P. 272.

"As will be seen from the list of common plants given, about three-fifths of them are mountain and highland forms in the United States, and extend into Canada as lowland forms. About one-third are inhabitants of low sphagnous swamps and marshes, while the remaining small fraction might be called lowland species." P. 272.

"In North America, as these immense fields of ice moved southward they pushed all the original and introduced flora before them, forcing highland forms into lowlands, and all forms farther south." P. 273.

"Others survived in sheltered places and by very slow adaptation to climate and awaited changes, which should give them a broader field and more favorable circumstances for a better development.

James.

. . . "Wallace has expressed it, that 'every species has come into existence coincident both in space and time with a pre-existing, closely-allied species.'"† P. 51.

"† Wallace, Contrib. to Nat. Selec., N. Y., 1871, p. 5."

"Therefore, when we find identical species in two different quarters of the globe, we believe the individuals in both localities to be descended from a common parent." P. 51.

"We may very reasonably suppose that during the warm period at the north the ocean was at a lower level than it is now,‡ and that a land connection formerly existed between the northwest coast of America and the northeast coast of Asia."

"‡ In consequence of the withdrawal of large quantities of water to form the Antarctic ice-cap, and because the shifting of the earth's centre of gravity caused by this ice would have a tendency to draw the water toward the south, thus leaving much dry land at the north.—Croll, 'Climate and Time.'" P. 65.

. . . "The region close around the North Pole is, as yet, a *terra incognita*. We know enough of it, however, to say with certainty that there is considerable land clustered in its vicinity." P. 65.

"Innumerable herbaceous species, too, found suitable homes in the forests and plains of the north at that time." P. 54.

[The list given by Coulter and Thompson is not divided in any way, so it is not possible to see which are highland or lowland forms. But in my paper they are divided into "strictly alpine species," "sub-alpine and other species having a north or northwestern range," "species living either entirely in the water, or else in swamps, marshes, and wet places."] Pp. 56, 57, 60.

"With such a mass of ice covering the country, all animal and vegetable life must either have been destroyed or else forced to migrate southward toward warmer regions." P. 53.

"The few remaining [of list No. 1] may be forms which have been developed from others, on account of the struggle for existence which ensued when left on the mountains during their

Coulter and Thompson.

No doubt this gradual change, produced by an attempted adaptation to climate and surroundings, will account for many of the very nearly related species and varieties in North America and the Eastern Continent." P. 273.

"Hence we must conclude that our North American flora has originated in the far North, and once flourished around the North Pole; that it was driven south by the cold of the glacial epoch," etc. P. 274.

James.

return to the north, at the close of the glacial epoch." P. 57.

[I conclude] "2nd. That the species of plants common to Europe and America have had a common origin in the land about the North Pole.

"3d. That they have migrated south on account of the cold in the Arctic regions," etc. P. 67.

These passages will give an idea of the similarity in thought between the two articles. There is no reference in any place to my article, although the authors must have had it before them. I submit that it is only fair to refer to an article from which so many ideas have been gleaned.—*Joseph F. James, Miami University, Oxford, O.*, October 10, 1887.

Ridgway's Manual of Ornithology.[1]—In this book we have the result of the knowledge of one of our first ornithologists, Mr. Robert Ridgway, brought fully up to date. No one is more competent for the task, and the student as well as the sportsman may rely implicitly on the statements contained in this book. The descriptions are all arranged in key form. This method is adapted to the presentation of brief definitions, especially those of the higher groups. When it comes to the presentation of the numerous characters of species it becomes awkward from a typographical point of view, and we fancy from the appearance it gives this volume that it will not replace the usual full paragraph form of description for species. In the keys of genera we observe with gratification that definitions are rarely based on color characters. The nomenclature is also thoroughly cleared up, and the results are a warning to all careless renamers. We regret, however, to observe that the author adheres to the practice of giving two identical names to a species, when the species name has been adopted for that of a genus. The result is a tautological absurdity. The references to exotic ornithology are one of the valuable features of the book.

Synopsis of the Flora of the Laramie Group.[2]—In this important paper Mr. Ward gives a general view of the subject in question, which embraces a total of 1540 species. "Of these

[1] A Manual of North American Birds, by Robert Ridgway. Illustrated by four hundred and sixty-four outline drawings of generic characters. Philadelphia: J. B. Lippincott Co., 1887.

[2] From the Annual Report U. S. Geol. Survey of the Territories, 1886, p. 400. By Lester F. Ward.

286 are Cryptogams and 1254 are Phanerogams. The Cryptogams are 119 cellular and 167 vascular, and the Phanerogams are 125 Gymnosperms and 113 are Angiosperms. The Angiosperms embrace 467 apetalous, 406 polypetalous, and 106 gamopetalous species." The comparison that is made between this flora and that of the Cretaceous systems below, and the Eocene above, is highly instructive. It is well known that the students of palæobotany have insisted that the evidence throws the Laramie into the Eocene series, while the cultivators of the palæontology of the Vertebrata have been equally certain that this system must be placed at the summit of the Cretaceous. The specialists in Invertebrata have not produced very strong evidence either way. It is therefore a matter of much interest that Mr. Ward, after this full survey of the flora, writes as follows: "Taking all these facts into consideration, therefore, I do not hesitate to say that the Laramie Flora as closely resembles the Senonian Flora as it does either the Eocene or the Miocene Flora. But again, I would insist that this does not necessarily prove either the Cretaceous age of the Laramie Group or its simultaneous deposit with any of the upper Cretaceous beds." To the palæontologist the above paragraph will be sufficient to settle finally the reference of the Laramie to the Cretaceous series, without regard to the question of synchronism. We are not fully acquainted with the true time-relations of the extinct floræ and faunæ of the northern hemisphere, but we have evidence enough to show that, whether exactly synchronous in different parts of this area or not, the nonconformity in time has not been very great.

The memoir is accompanied by numerous illustrations.—*E. D. Cope.*

Keep's West Coast Shells.[1]—This is a popular work of convenient size for the pocket, and on a subject which is interesting to every lover of nature. With its help the student may identify the species in their haunts, not by a system of scientific analytical keys, but by the aid of excellent wood-cuts, and appropriate descriptions of their external characters. As a book for the amateur, and as introductory to a more severe scientific treatment of the subject, this book is admirably adapted.

Batrachians and Reptiles of Central America and Mexico.—In this Bulletin (No. 32) of the United States National Museum Prof. E. D. Cope has published a synonymic and geographical catalogue of the animals referred to in the title. The

[1] West Coast Shells. A Familiar Description of the Marine, Fresh-Water, and Land Mollusks of the United States found west of the Rocky Mountains. By Josiah Keep, A.M. San Francisco: Bancroft Bros. & Co., 1887.

richness of the region in question is shown by the fact that they number in total 705 species, which are divided among 197 genera. Of the 705, 135 are Batrachia and 570 are Reptilia. Of snakes there are 315 species, of which 45 are venomous. The family of Colubridæ alone contains 243 species. The other families, which include over twenty species, are (snakes) Crotalidæ; (lizards) Scincidæ, Anguidæ, Iguanidæ, Anolidæ; (frogs, etc.) Cystignathidæ, Hylidæ, and Bufonidæ. Three new genera are described: Diaglena for the *Triprion spatulatus* of Günther; Dipeltophis for the *Leptognathus albocinctus* of Fischer; and Ophryacus for the *Atropus undulatus* of Jan. Two new species are described, *Scytopis boulengeri* and *Elaps bernadi.*

This Bulletin is an illustration of the delays of the United States Government printing-office. Handed in to the secretary of the Smithsonian Institution January 16, 1886, it is not published until October 16, 1887.

Illustrations of Vivisection.[1]—The errors of the antivisectionists have been so often set forth that it would seem unnecessary to repeat them, especially in view of the fact that the society that issues this pamphlet did at one time restrict its efforts to the very proper restraint of unnecessary and needlessly cruel vivisection. But in reprinting extracts from the papers of that irrepressible and irrational lady, Miss Frances Power Cobbe, the society lays itself open to a repetition of all the just complaints made against their movement by the science of the day. Dogs and rabbits strapped to holders in awkward positions may excite the sympathy of the ignorant, just as a horse on his back in the street may do, but appeals by such means to the sympathies of enlightened people will only excite a smile. Even less elegant and æsthetic are the scenes daily witnessed on the operating-table of the surgeon, but men and women submit to them for the good of themselves and of their families. The superstition that a muscular spasm necessarily produces pain is here played upon, and various operations are depicted, most of which are painless. In the infliction of suffering, however, which accompanies some of the physiological experiments, the humane scientific man takes no more pleasure than the antivivisectionist. He is only sustained in it by the knowledge that the benefit to mankind overbalances the suffering inflicted on the animal. This pamphlet is one of the illustrations of one of the noblest of human qualities gone wrong.

[1] Illustrations of Vivisection, or Experiments on Living Animals, from the Works of Physiologists, namely, Claude Bernard and Paul Bert, as reproduced in "Bernard's Martyrs" and "Light in Dark Places." By Miss Frances Power Cobbe. Philadelphia: American Society for the Restriction of Vivisection.

RECENT BOOKS AND PAMPHLETS.

Weismann, A.—Ueber die Zahl der Richtungskörper und über ihre Bedeutung für die Vererbung. Jena, 1887. From the author.

De Man, J. G.—Uebersicht der indo-pacifischen Arten der Gattung *Sesarma*, Say. Ext. Zool. Jahrb., 1887. From the author.

——Bulletins U. S. Geol. Survey, Nos. 34–39. From the Survey.

Shufeldt, R. W.—Contributions to the Comparative Craniology of the North American Indians. Ext. Jour. Anat. and Phys., 1887. From the author.

Farlow, W. G.—The Task of American Botanists. Ext. Pop. Sci. Mo., 1887. From the author.

Beddard, F. E.—Note on a New Type of Compound Eye. Ext. Ann. and Mag. N. H., 1887. From the author.

GENERAL NOTES.

GEOLOGY AND PALÆONTOLOGY.

Zittel's Manual of Palæontology.[1]—Professor Zittel's Manual of Palæontology has now passed beyond the Invertebrata, and in the present part it enters the Vertebrata. This work appears to me to be the best synoptical manual of the subject which has yet appeared. Its scope is more comprehensive than that of most works of the kind, and its contents are more nearly brought up to the present date. In illustration it is especially meritorious, both in quantity and quality of figures. That the opportunities of its author are of the best, follows from the well-known excellence of the Museum of Munich; and his wide knowledge of the literature of the subject is displayed by the author at appropriate points in the work.

In the present part, the subject is completed as far as the end of the fishes usually enumerated under the name of Ganoids, which term, as is well known, includes all the palæozoic and many of the mesozoic forms. These, with the preceding sub-class of Selachii, are treated with much fulness of description and illustration. A great deal of information as to the structure of certain forms of these fishes is here brought together, information which has been hitherto largely inaccessible in America. The subject can be now intelligently studied here.

While we speak highly of most of the characteristics of this work, we cannot approve of the system in which the subject-matter is arranged. The inclusion of the Leptocardii and Cyclostomi among fishes is a distinct departure from the modern systems of classification, while the admission of a sub-class, "Ganoidei," is a concession to tradition rather than an expression of exact taxonomy. Then the inclusion of such forms as Pteraspis,

[1] Handbuch der Palæontologie. Herausg. v. K. A. Zittel, Prof. a. d. Univ. zu München, mitwirkung von Dr. A. Schenck. I. Abtheilung Palæozoölogie, III., vol. i. Lief. München u. Leipzig: R. Oldenbourg. 8vo.

Pterichthys, and Bothriolepis in this "sub-class" is certainly a violation of the precision of definition which all true systems should possess. Dr. Zittel says indeed of the Pteraspididæ that their position is entirely undecided. The "orders" of "Ganoidei" we find to be unnatural in various respects. We also object to the use of family terminations for orders, and ordinal terminations for families, which the authors of the work have adopted.

The fulness of this part of the subject as presented by Professor Zittel enables the reviewer to give a synopsis of his own views on the subject of the classification of the lowest Vertebrata, to which he has hitherto only contributed fragments.[1] This is now done in anticipation of a fuller memoir with complete illustrations.

Preliminarily, the following point, originally propounded in substance, I believe, by Professor Haeckel, is adhered to:

I. *No vertebrate which lacks the mandibular and scapular arches is a fish.*

On this account I have declined to include in the Pisces such forms as the Pterichthyidæ and Bothriolepididæ, also the Pteraspididæ and Cephalaspididæ, but have referred the latter of them to the Haeckelian class Agnatha, which also includes the Marsipobranchi, or lampreys. (See NATURALIST, 1886, 1027.)

II. *The primary divisions of fishes are indicated mainly by their cranial structure.*

This is an expression of the fact generally admitted by zoologists, that there are at least four primary divisions so defined,—viz., the Holocephali, the Dipnoi, the Selachii, and a fourth division, which was first named by Professor Sir Richard Owen, the Teleostomi.

III. *The divisions of the Teleostomi are indicated by fundamental modifications of their fin-structure.*

This taxonomic truth was first insisted on by the writer (*Transac. Amer. Philos. Soc.*, 1870, p. 445), and is now repeated with emphasis. The probably correct evolutionary view of Dohrn regards the fins as remains of three or four primitive longitudinal epiblastic folds, which have been supported by mesoblastic segments radiating from the central axis of the skeleton, and which have developed actinotrichia (mesoblastic, Ryder) within themselves, which have become ultimately correspondent, and articulated with, the internal mesoblastic segments, as fin-rays. I maintain that the phylogeny of the primary types of the Teleostomi will be found to be expressed in the successive stages exhibited by the process of the reduction of the internal bony

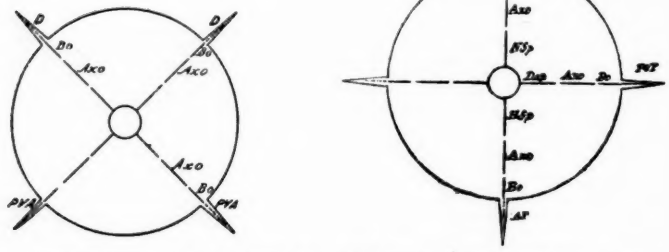
[1] Transactions of the American Philosophical Society, 1870, p. 445; "On the Classification of the Extinct Fishes of the Lower Types," Proceed. Amer. Assoc. Adv. Sci., 1878, p. 292; "On an Interesting Genus of Chordata," Naturalist, 1886, p. 1027.

supports of the external folds, to the proportions and positions which we behold them to present in the different groups of fishes.

IV. *The orders of fishes are defined by modifications of the skeleton of lesser significance than those included in statements II. and III.*

Under this head come modifications in the structure of the skull, vertebræ, and fins in which the multifarious character of fish evolution has displayed itself, and in which relation to the other classes of Vertebrata does not enter as an element of estimation.

In accordance with proposition III. I define what appear to me to be the primary divisions of the Teleostomi. Before doing so I will state the elements of the definition. The supports of all the fins consist primitively (in the case of the pectoral fins, the evidence is only partly in our possession) of at least three longitudinally connected osseous elements. These correspond to what have been named (1) the neural and hæmal spines of the vertebræ, (2) the axial segments[1] (interneural and interhæmal bones), and (3) the basilar segments[2] (so called because when present they are



EXPLANATION.—*D*, *DF*, dorsal fin; *PVF*, pectoral and ventral fins; *PVA*, pectoral, ventral, and anal fins; *AF*, anal fin; *NSP*, neural spine; *Dap*, diapophysis; *HSp*, hæmal spine; *Axo*, axonost; *Bo*, baseost.

the immediate supports of the fin-rays). I first used the terms axial and basilar for these segments (in 1870) as homologous in all the fins, a view which has been since adopted by the distinguished embryologist Ryder, who uses the following language (l. c., p. 985): "Regarding the whole of the mobile axial skeleton of the Lyrifera (= Pisces) as essentially homologous, I will call

[1] Proc. Amer. Philos. Society, 1877, May.

[2] Cope, Transactions Amer. Philos. Society, 1870, p. 445; Ryder, "The Origin of Heterocercy and the Evolution of the Fins and Fin-Rays of Fishes;" Report U. S. Fish Commission, 1886, pp. 985, 1017. The terms "actinost" (Gill) and "actinophore" (Ryder) were subsequently applied to the basilars.

the distal parts which directly support the true rays as *actinophores*." Those who prefer a substantive appellation for these elements may call them *axonosts* and *baseosts*. The only fin which does not present us with the series of three in some known type is the pectoral, though Tristichopterus (*teste* Traquair) may do so. The axonost is sometimes represented by more than one segment,—*e.g.*, Dipnoi, of which the proximal is the mesopterygium of Gegenbaur. It is accompanied in the Selachians by several other axonosts, which are equally in contact with the scapular arch. In Lepidosiren and Ceratodus it is not yet possible to determine how many of the pectoral segments belong to the axonost and how many to the baseost.

Next to the pectoral fin, the caudal presents us with the greatest divergence from the primitive condition; and next to it, the ventral fin departs most widely. The pelvic element so called is the axonost of this fin. The dorsal and anal fins depart less considerably from the type than any of the others, but the modifications are important, and have been mostly neglected in taxonomy. The following are the natural divisions represented by these modifications. They may be called superorders:

Dorsal, anal, pectoral, and ventral axonosts present, represented by a single element to each fin. *Rhipidopterygia.*

Dorsal, anal, pectoral, and ventral axonosts present; the dorsal and anal numerous, each articulating with a single baseost, if any; the pectoral axonosts present in variable number, articulating with numerous well-developed baseosts; the ventral axonost single, articulating with numerous baseosts; . . . . . *Crossopterygia.*

Dorsal and anal axonosts as in the last; no pectoral axonost, baseosts rudimental; a ventral axonost with numerous baseosts; . . . . *Podopterygia.*[1]

Dorsal and anal axonosts as in the last; pectoral axonost none, baseosts very few, small; ventral axonost present, with minute or no baseosts; *Actinopterygia.*[2]

The orders and families of these superorders appear to the writer to be as follows:

RHIPIDOPTERYGIA.

Baseosts present in dorsal and anal fins; . *Rhipidistia.*

Baseosts wanting to dorsal and anal fins. Caudal axonosts present, each one articulating with a neural spine (Huxley); . . . . . *Actinistia.*[3]

[1] Chondrostei, Owen, Cope, olim.
[2] Actinopteri, Cope, olim.
[3] Transac. Amer. Philosoph. Soc., 1870, pp. 450, 451.

CROSSOPTERYGIA.

A. Dorsal baseosts present.

Dermal rays (actinotrichia, Ryder) more numerous than baseosts; each axonost articulates with a neural spine; . . . . . *Haplistia.*[1]

Dermal rays equal in number with, and articulating with baseosts; . . . . . *Taxistia.*

AA. No dorsal baseosts.

Dermal rays equal in number with, and articulating with basilars; axonosts not articulating with neural spines; . . . . . *Cladistia.*[1]

ACTINOPTERYGIA.

I. Dermal radii more numerous (octinotrichia) than the baseosts and axials.

Intercentra distinct, small; . . . . . *Lysopteri.*[2]

II. Dermal radii equal baseosts and axonosts.

Vertebræ with distinct intercentra on the chorda dorsalis; . . . . . *Merospondyli.*

Vertebra with completed intercentra, which are amphicœl or annular; . . . . . *Isospondyli.*

Vertebræ with completed intercentra, which are opisthocœl; . . . . . *Ginglymodi.*

Vertebral column with completed intercentra and centra, both amphicœl; . . . . . *Halecomorphi.*

The other orders of the Actinopterygia and those of the Podopterygia are enumerated in my various papers on the recent fishes. Of the above, all are extinct excepting the Cladistia, the Isospondyli, Ginglymodi, and Halecomorphi. The families are the following. To the *Rhipidistia*, one family, the Tristichopteridæ. In it there is but one, a normal caudal fin, and the vertebræ are externally ossified. (Günther and Traquair.) The *Actinistia*, one family, the Cœlacanthidæ. In the latter there are two caudal fins, and the vertebræ are not ossified. The *Haplistia*, one, the Phaneropleuridæ (Zittel does not think this family Dipnoan as has been supposed). The *Taxistia*, two, the Cyclodipterini and Glyptodipterini, which should be called the Holoptychiidæ, and the Osteolepididæ. The *Cladistia*, one family, the Polypteridæ. The *Lysopteri*, one family, the Palæoniscidæ, from which the Platysomidæ is scarcely distinct. The *Merospondyli* embraces the Sauropsidæ[3] (= Microlepidoti and Cyclolepidoti, Zittel) and the Pycnodontidæ, with other families embracing more or less numer-

[1] Loc. cit. I endeavored (l. c.) to prove that the vertical spines supporting the finnules of Polypterus are basilars, but I do not now consider this view correct.

[2] Cope, Amer. Naturalist, 1880, p. 440; *Heterocerci* Zittel, 1887.

[3] Cope, Proc. Amer. Assoc. Adv. Science, 1878, p. 298, with the Lysopterous genera omitted.

ous genera, referred by Zittel to the families Stylodontidæ, Sphærodontidæ, and Saurodontidæ. Genera with annular intercentra, as Aspidorhynchidæ (Rhynchodontidæ, Zitt.), should be referred to the Isospondyli. Until the vertebral columns of the genera are better known, it will be difficult to decide which belong to the Merospondyli and which to the Isospondyli.

The Placodermi, after the exclusion of the Pteraspididæ, Cephalaspididæ, Pterichthyidæ, and Bothriolepididæ, form a homogeneous order. So far as the structure of the fins is known, it appears to belong to the superorder of the Actinopterygia,[1] but this is not fully established. If so, it appears to have the dorsal and anal fin-rays equal in number with the baseosts, and these to be equal in number and continuous with the axonosts (according to Von Koenen, in *Coccosteus inflatus*), characters not known in any other order of Actinopterygia. But one family is certainly known, the Coccosteidæ, which has a hinge-like articulation of the epiclavicular or clavicular plate with the cranium.

The descriptions and figures of Professor Zittel render it perfectly clear that the fishes rarely develop complete vertebral centra, the order Halecomorphi being the only example. The so-called centra of fishes are intercentra as in the Batrachia.[2] This is an important addition to the evidence of the affinity of these two classes of Vertebrata. It also shows that the mechanical origin of the rhachitomous vertebra in the fishes is the same as that which I have pointed out in the Batrachia, viz., as the effect of lateral flexures of the notochord on ossifications of the sheath. The Selachii have not experienced the rhachitomous stage, so far as yet known, because the primitive ossification has not been confined to the sheath of the notochord.—*E. D. Cope.*

A Saber-tooth Tiger from the Loup Fork Beds.—The White River and John Day Miocene formations in North America are well known to contain remains of saber-tooth cats of the family of Nimravidæ, while the Pliocene epoch has produced two species of saber-tooths of the family Felidæ. Hitherto the Loup Fork, or Upper Miocene formation, which intervenes between the John Day and the Pliocene, has produced no cats of this type. Under the circumstances it was to have been anticipated that they existed during this time, and I can announce that this supposition may be now exchanged for knowledge. A part of the mandible of a large cat has been in my possession for a considerable time, and I propose to describe the species it represents under the name of *Machærodus catocopis.*

Two characters first attract the attention; these are, first, the very large size of the inferior canine as compared with the in-

[1] See Naturalist, 1886, p. 1031, where it is provisionally referred to this superorder.

[2] See "The Intercentrum of the Terrestrial Vertebrata," Transac. Amer. Philos. Soc., 1886, p. 243, by E. D. Cope.

cisors; and, second, the slight development of the flange of the lower jaw. The angulation of the anterior part of the lower jaw is very well defined, but does not descend as a flange below the level of the inferior border. The anterior face is well distinguished from the lateral by the vertical angle, which is, however, obtuse. The form is quite similar to that in *Nimravus gomphodus*. The superior half of the anterior face is, in fact, deeply grooved on the middle line, a circumstance due to the large size of the canine and small size of the incisors. The latter are three in number, and the roots are much compressed, and so crowded as to alternate with each other. The crowns are lost. The canine is considerably compressed, and has a sharp serrulate posterior cutting edge, which descends to the base of the crown behind. There is no anterior cutting edge. The shape of a section of the tooth is lenticular, the anterior angle rounded off; the long axis extends a little oblique to the median line. The apex is lost. There are three foramina on one side, and two on the other of the median symphysis; and there are three mental foramina on the best preserved ramus.

Measurements.

		M.
Depth of symphysis		.068
Width of symphysis at middle		.031
Width of space between inferior canines		.028
Diameters inferior canine	antero-posterior	.020
	transverse	.013

The large size of the inferior canine might lead to the inference that the superior canine is not so large as in the typical saber-tooths. It certainly exceeds in this respect the other known species. The small flange cannot sustain this inference, since it is similar in Nimravus, which has a large superior canine. The present species is the largest saber-tooth of North America, except perhaps the *Simlodon fatalis* Leidy. The specimen on which it is based was found by Frank Hazard in Phillips County, Kansas.—*E. D. Cope.*

Note upon the Genus Athrodon.—In a paper upon the "Structure and Classification of the Mesozoic Mammalia" (*Proceedings Philadelphia Academy*, June, 1887) I proposed the genus *Athrodon*, founded upon the maxilla referred to *Stylodon pusillus* by Professor Owen in his memoir upon the Mesozoic Mammalia. Professor Cope has kindly called my attention to the fact that *Athrodon* is preoccupied by Sauvage (*Bull. Soc. Geol.*, 1880, viii. p. 530) for a genus of Ganoid fishes. I therefore propose to substitute the term Kurtodon for *Athrodon* to embrace this genus of mammals.—*H. F. Osborn.*

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.—*Langbanite* is the name applied by G. Flink[2] to a mineral which occurs in small black hexagonal crystals in a granular limestone at Långban, Sweden. In habit it is tabular or prismatic, with the prism faces but slightly developed. Its hardness is 6.5, specific gravity = 4.918. Its axial ratio is 1 : 1.6437. Its analysis yielded,—

Sb_2O_5	SiO_2	MnO	FeO
15.42	10.88	64.00	10.32

The discoverer regards it as silicate of manganese (Mn_3SiO_7) combined with antimonate of iron ($Fe_3Sb_2O_8$) in the proportions 37 : 10.——*Webskyite.*—This mineral, named by R. Brauns[3] after the late Professor Websky, of Berlin, is a decomposition product of the serpentine occurring in the paleopikrite of Amelose, near Biedenkopf, in Nassau. It occurs in black amorphous masses, with a bluish-green streak. Its hardness is 3 and its specific gravity 1.771. It is apparently isotropic in thin sections, where it possesses a green color. Its composition is as follows:

SiO_2	$Al_2O_3.Fe_2O_3$	FeO	MgO	H_2O	Loss at 110°
34.91	9.60	3.13	21.62	9.84	21.20

This corresponds to the formula $H_6R_4Si_3O_{13} + 6H_2O$, in which R = Mg and Fe.——*Laubanite* is described by Traube[4] as a new zeolite from the druses of the basalt occurring near Lauban, in Silesia. Its color is milk-white. It possesses a short columnar habit and a hardness of 4.5–5. It is found only in small crystals, implanted on phillipsite and other associated minerals. These crystals under the microscope are seen to be composed of little bundles of fibres. Its composition approaches very near to that of laumontite, from which it differs only in its percentages of calcium and water of crystallization.

Laubanite.	Laumontite.	Phillipsite.
$Al_2(SiO_3)_3$	$Al_2(SiO_3)_3$	$3Al_2(SiO_3)_3$
$2Ca(SiO_3) + 6H_2O$	$Ca(SiO_3) + 4H_2O$	$2Ca(SiO_3)$
		$K_2(SiO_3) + 12H_2O$

Recent Investigations of American Minerals. *Mica.*—Prof. F. W. Clarke,[5] of the U. S. Geological Survey, has recently published an interesting paper in which the relations between three American iron-micas are discussed. The three micas in question are lepidomelane from Baltimore, Md., and from Litchfield, Me., and annite from Rockport. Their compositions may be represented by the formulas

$R'_6R''_4R'''_2Si_5O_{20}$ (Rockport); $R'_6R''_3R'''_4Si_5O_{22}$ (Baltimore); and $R'_6R''_2R'''_6Si_5O_{24}$ (Litchfield).

[1] Edited by DR. W. S. BAYLEY, Madison, Wisconsin.
[2] Zeitschrift für Krystallographie, xiii., 1887, p. 1.
[3] Neues Jahrb. f. Min., etc., Beil. Band., v., 1887, p. 318.
[4] Ib., ii. p. 64.
[5] Amer. Jour. Sci., xxxiv., Oct. 1887, p. 131.

The relations existing between them may be best shown by supposing two of the univalent groups (AlO) to replace one (R'''_2O_2). Assuming this, the formulas may be written:

$$R'_{14}R'''_2(SiO_4)_5 = \text{Rockport mica.}$$
$$R'_{12}(AlO)_2R'''_2(SiO_4)_5 = \text{Baltimore mica.}$$
$$R'_{10}(AlO)_4R'''_2(SiO_4)_5 = \text{Litchfield mica.}$$

In the same paper there are also given analyses of iron-micas from Auburn, Me., and Pike's Peak, Colorado, and one of a muscovite from Alexander County, N. C., containing 1.10 per cent. of TiO_2.——*Howlite.*—This mineral was first identified by Professor H. How,[1] of Windsor, Nova Scotia, who named it silico-borocalcite. Messrs. Penfield and Sperry,[2] having recently come into the possession of a comparatively pure specimen of the mineral, have re-examined it. They find it to be composed as follows:

SiO_2	B_2O_3	CaO	Na_2O	K_2O	H_2O
15.33	44.52	27.94	0.53	0.13	11.55

They regard it as a distinct species with the formula $H_5Ca_2B_5SiO_{14}$.——*Cassiterite.*—The tin-stone of Mexico is divided by Professor Genth[3] into two varieties, a red and a yellow variety. Both are supposed to have been formed by precipitation from solution. The red variety is found in very small crystals, with a hexagonal habit. Analysis shows it to consist of dioxide of tin, containing a little ferric oxide and occasionally small quantities of arsenic pentoxide. The yellow variety occurs principally in imitative forms. It contains very little ferric oxide, but considerable arsenic pentoxide, and always an admixture of zinc oxide. Crystals of cassiterite implanted on hematite (after the manner of rutile on hematite from St. Gothard), and pseudomorphs of the former after the latter mineral, as well as after magnetite, are described by Professor Genth as not very uncommon in the sands and ores from the state of Durango.——*Mimetite* has been found in small crystals at the Mina del Diablo, Durango, Mexico. More frequently, however, it occurs in pseudomorphic forms after an unknown mineral, supposed by Dr. Genth[4] to be anglesite, by Professor von Rath to be galena, and by Dr. Brezina to be mendipite.——*Vanadinite.*—This mineral occurs on quartz in the Mammoth Gold Mine, near Oracle, Pinal County, Arizona. It is sometimes coated with calcite, which is in turn coated with a second generation of vanadinite. Other localities for vanadinite are Yavapai County, Arizona; McGregor Mine, Grant County, New Mexico; and Bald Mountain Mine, Beaverhead County,

[1] Philos. Mag., iv. xxxv., p. 32. [2] Amer. Jour. Sci., Sept. 1887, p. 220.
[3] Contributions from the Chemical Laboratory of the University of Pennsylvania, xxix., 1887, p. 4.
[4] Ib., p. 10.

Montana.——*Descloizite* (*ramirite*), from San Luis Potosi, Mexico, yielded Professor Genth [1] on analysis the figures,—

PbO	CuO	ZnO	As_2O_5	V_2O_5	P_2O_5	Loss on ignition
54.52	6.58	12.70	3.63	19.99	0.13	2.62

a result not very different from that obtained by Penfield [2] in 1883.——*Tapalpite*, from the Sierra de Tapalpa, Jalisco, Mexico, is regarded by Rammelsberg as being represented by the formula $Ag_2S.Bi_2Te_2$. Professor Genth [3] has analyzed some comparatively pure material, with this result:

Ag	Pb	Bi	Cu	Te	S
38.59	7.24	25.05	0.21	17.43	8.24

which, after deducting the impurities, would give, as the composition of tapalpite,

Ag	Bi	Te	S
46.09	24.99	21.67	7.25

corresponding to a normal sulpho-telluro salt of silver and bismuth.——In the paper in which the above-mentioned minerals are discussed, Professor Genth describes *pyrite* pseudomorphs after *pyrrhotite*, from Colusa County, Cal.; *hessite*, from Tombstone, Arizona; *allanite*, from Statesville, N. C.; *willemite*, from Socorro County, New Mexico; and *hisingerite* pseudomorphs after *calcite*, from Ducktown, Tenn.——*Bismutho-sphærite.*—This mineral has for some time been regarded as a basic carbonate of bismuth, but its composition has not until very recently been determined by means of analysis. A short time ago Mr. H. L. Wells [4] obtained large specimens of the mineral from Willemantic and Portland, Conn. The Willemantic occurrence is described as a dark-gray mineral, holding in its centre a nucleus of bismuthinite. Its specific gravity is 7.42. Under the microscope it was seen to consist of a dark ground-mass, in which patches of a pale yellowish-green color are scattered. The dark portion is almost opaque from the numerous black dust-like inclusions it contains. These are supposed to represent traces of the original mineral from which the bismutho-spharite was derived. An analysis yielded,—

Bi_2O_3	SO_3	Silicates	CO_2	H_2O
91.64	0.34	0.08	8.03	0.47

corresponding to the formula $Bi_2O_3.CO_2 = (BiO)_2CO_3$.——*Crocidolite.*—Messrs. Chester and Cairns [5] have recently published an analysis of the bluish-gray fibrous crocidolite from Beacon Pole Hill, near Cumberland, Rhode Island, with the result (as the mean of two analyses):

SiO_2	Fe_2O_3	FeO	MgO	Na_2O	H_2O
51 58	16.90	21.22	0.15	6.34	3.79

[1] Ib., p. 15.
[2] Amer. Jour. Sci., xxvi. p. 361.
[3] L. c., p. 18.
[4] Amer. Jour. Sci., October, 1887, p. 271.
[5] Ib , xxxiv., 1887, p. 108.

This composition is represented by the authors by the formula $Fe_3Na_2H_4Fe_2(Si_9O_3)_9 = 3FeO.Na_2O.2H_2O.Fe_2O_3.9SiO_2$, in which the water is regarded as basic. The authors cannot accept the prevalent view that crocidolite is merely a fibrous arfvedsonite. ——*Datholite.*—Mr. Whitfield[1] has analyzed the datholite from Bergen Hill, N. J., determining the boric acid by the Gooch[2] method. His figures are:

SiO_2	FeO	CaO	B_2O_5	H_2O
35.74	0.31	35.14	22.60	6.14

corresponding to the formula $B_2O_3.H_2O.2CaO.2SiO_2 = H.CaSiO_3.BO_2$, the generally accepted formula for this mineral.——*Ulexite.*—Ulexite, from Rhodes Marsh, Esmeralda County, Nevada, yielded the same analyst[3] the following figures:

SiO_2	Cl	B_2O_3	SO_3	CaO	Na_2O	K_2O	H_2O
0.04	2.38	43.20	0.28	14.52	10.20	0.44	29.46

These figures are represented by the formula $NaCaB_5O_9 + 6H_2O$, after making certain allowances for impurities.——*Siderite* (*sphærosiderite*).—This mineral[4] occurs at Baltimore, Md., associated with zeolites in the gneiss of the Jones Falls quarries. The crystals are small and lenticular in shape. They possess only the forms R and oR, except in one instance, where the negative scalenohedron $-\frac{1}{4}R^4$ is supposed to occur. In these crystals the faces are generally rounded, forming a lens-shaped body. Frequently two of these lenses are grouped together so as to form apparent twins. And further, many lenses grouped together produce a perfect sphere. Analyses of selected material by Mr. A. G. Palmer gave,—

FeO	MgO	MnO	ZnO	CO_2
59.63	1.05	0.91	1.72	37.93

It is thought that the presence of manganese and zinc may have had some influence in the production of these rounded forms, not uncommon in the pure manganese carbonate-rhodochrosite. ——*Samarskite.*—Samarskite[5] is found in the coarse-grained granitic veins cutting the schists in which the zeolites (referred to above) occur. It is described by Professor König as a very splintery, black mineral with a hardness of about 6–7. Its specific gravity is 6.146. An analysis yielded,—

Metallic acids	UO_2	Y, Er, etc.	(CeTh)O	FeO
56.40	13.48	11.90	3.85	8.98
Fe_2O_3		Al_2O_3	Ignition	
1.66		2.00	0.30	

[1] Ib., October, 1887, p. 281.
[2] Amer. Chem. Jour., ix., 1887, p. 23, and ii., 1880, p. 247. [3] L. c.
[4] Notes on the Minerals occurring in the Neighborhood of Baltimore, by G. H. Williams, Ph.D., Baltimore, 1887, p. 12.
[5] Ib., p. 16.

The specific gravity of the metallic acids (5.769) is too high for niobic acid, while no tantalic acid was detectable by Rose's method,—facts which Professor König does not understand.——*Beaumontite.*—Several crystals of this mineral have recently been measured by Messrs. Burton and Gill,[1] who find no reason to suppose that it is not crystallographically identical with heulandite, as Des Cloizeaux found it to be in its optical properties.——*Rutile.*—The rutile crystals occurring in the spodumene-bearing pockets of the gneiss in Sharp's township, Alexander County, N. C., are described by Messrs. Hidden and Washington[2] as small, with the rare basal pinacoid prominent and well polished. Measurements of these crystals resulted in the detection of the new forms $\frac{2}{7}$P, $\frac{1}{2}$P, $\frac{2}{3}$P, 4P, and P$\frac{9}{8}$. A recalculation of the axial relations gave 1 : 0.64425.——*Apatite.*—A small crystal of apatite implanted on muscovite, from the same locality as that mentioned for rutile, is described by the same writers as almost unique in habit, the prisms $\frac{1}{2}$P, P, and 2P2 predominating. From data obtained in the measurement of this crystal, a recalculation of the axial relations for apatite gives this as 1 : 0.7343. A cruciform twin of apatite is described and figured, in which the twinning plane is 2P2. This is interesting as the first description of a twin of this species.——*Beryl.*—Two new planes have been discovered by the same authors on the emerald beryls of the Alexander County locality. These planes are $\frac{1}{12}$P and $\frac{15}{7}$P$\frac{15}{8}$. On all the beryl from this locality it was observed that the prism face ∞P is perfectly smooth, while ∞P2 is covered with little triangular pits.——*Quartz.*—Some time ago Vom Rath[3] noted the occurrence of the plane ∞P$\frac{4}{3}$ on the alternate prismatic edges of certain quartz-crystals from Alexander County, N. C. Messrs. Hidden and Washington[4] find this same form holohedrally developed in each consecutive prismatic edge.——*Topaz.*—A clear crystal of topaz[4] from Zacatecas, Mexico, contains the new plane 7P∞.——*Pyroxene.*—Certain crystals of pyroxene from Orange County, N. Y., possess[5] a tubular habit due to the development of the basal plane, and are remarkable besides in that they are hemimorphic in the direction of the vertical axis. The upper portions of the crystals show the forms oP, —P, P, 2P, ∞P, ∞P$\frac{3}{2}$, and ∞P∞. Moreover, the lower planes are so developed that these portions of the crystals must be regarded as twinned, while the upper portions are simple individuals.——*Scorodite.*—In a late number of the *American Journal of Science*, Mr. Hague[6] discusses the deposition of scorodite from the arsenical waters of the Yellowstone National Park. The mineral occurs as a green coating covering the siliceous sinter de-

[1] Ib., p. 10.
[2] Amer. Jour. Sci., xxxiii., 1887, p. 501.
[3] Zeits. f. Krystal., xii., p. 456.
[4] L. c.
[5] G. H. Williams, Amer. Jour. Sci., Oct. 1887, p. 275.
[6] September, 1887, p. 171.

posited by the Joseph's Coat Springs and other geysers, and is also often found in little nodules in the cavities of this sinter. An analysis of the purified scorodite yielded Mr. Whitfield,—

Fe_2O_3	As_2O_5	H_2O
34.94	48.79	16.27

Analyses of the waters of these geysers show a small percentage of arsenious acid.——Reusch[1] has examined the crystallized *kaolin* from Denver, Colorado, to which Cross and Hillebrand first called attention.[2] He declares it to be triclinic and not orthorhombic as Hillebrand supposed.——A. Kenngott[3] describes two peculiar crystals of *gypsum* from Poland, Ohio, and calls attention to a new formula for *tantalite* from Dakota, based upon the analysis of Schaeffer,[4] published a few years ago.

BOTANY.[5]

The Genus Geaster.[6]—Dr. G. B. De Toni, of the Botanical Institute of the University of Padua, has lately made a careful revision of the genus Geaster. Accepting, with Fries, the definition of the genus as proposed by Micheli in 1729, after much reduction, he increases the number from fourteen, as enumerated by the illustrious Swedish savant in 1829, to forty-eight well-authenticated species. Making a careful study of the leading features of the species, he has been enabled to arrange them into seven quite distinct and fairly recognizable sections, as follows:

1. COLUMNATI.—*Inner peridium supported on several pedicels.*

This section includes the singular *G. coliformis* Dicks. with many mouths to the inner peridium, and *G. columnatus* Lev., from Chili, having but a single orifice.

2. FORNICATI.—*Outer peridium separating into two distinct strata, one obversely fornicate.*

This contains three species,—*G. fornicatus* Huds., and the little-known *G. radicans* B. & C., and *G. welwitschii* Mont. We may here remark that this fibrous lowest stratum clinging to the earth exists in *G. limbatus* Fr., and perhaps in several other Geasters.

3. CUPULATI.—*Outer peridium augmented by a membranaceous, often irregular cupule about the base of the inner peridium.*

This section contains only *G. triplex* Jungh. and the uncertain *G. duplicatus* Chev. We have observed this basal membrane in other species of Geaster; it occurs as a mere incidental breaking away of the lower portion of the inner fleshy stratum of the outer peridium. Specimens of *G. duplicatus* are to be found

[1] Neues Jahrb. f. Min., etc., 1887, ii., p. 70. [2] Bull. U. S. G. S., No. 20.
[3] Ib., 1887, ii., p. 84. [4] Amer. Jour. Sci., 1884, xxviii., p. 430.
[5] Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.
[6] "Revisio monographica generis Geasteris, Mich." Auctore Dr. G. B. De Toni. Revue Mycologique, No. 34, Avril, 1887.

without the basal cupule, though it is generally present in all fully-grown examples. This leads us to suggest that it might be well to distribute the species of sections 2 and 3 among those that follow.

4. STRIATI.—*Peristome sulcate-plicate or pectinate-striate.*

A well-marked section! It comprises ten species. The salient species are *G. bryantii* Berk., *G. umbilicatus* Fr., and *G. striatus* D. C.; the others cluster about them as more or less closely-related species. The five species, *G. striatus*, *elegans*, *striatulus*, *ambiguus*, *drummondii*, form an elegant group of remarkably near relatives.

5. FIMBRIATI.—*Peristome fimbriate-floccose or ciliolate, situated in a circular, distinctly radiate-fibrillose areola.*

This section comprises the largest number of species (twenty altogether). The well-known species are *G. minimus*, *limbatus*, *fimbriatus*, *mammosus*, *saccatus*. It contains a curious xylophilous group of four species, represented by the *G. mirabilis* Mont. The numerous species clustering about *G. fimbriatus* Fr. and *G. saccatus* Fr. are difficult of definition; these two are near enough related, the presence and absence of the circular areola being the only obvious mark.

6. PAPILLATI.—*Peristome papilliform, glabrous.*

This section contains two small species,—*G. floriformis* Vitt. and *G. pusillus* Fr.,—which may be identical.

7. EXAREOLATI.—*Peristome either dentate, always destitute of the circular areola, or irregularly or stellately dehiscing.*

This section comprises nine species, including the well-known *G. rufescens* Pers. and *G. hygrometricus* Pers.

Besides the forty-eight species of these seven sections there are five additional species less known or imperfectly described, among them the singular *G. linkii* Spreng., which does not seem to have been found by any one except Link and Schweinitz. If there are specimens of it in Schweinitz's herbarium, they should be carefully described.

There is an interesting table of the geographical distribution of the species. The seventeen species in the United States might have been increased by the addition of *G. coliformis*, from the *Journal of Mycology*, vol. i. p. 7.

Two good plates figure several characteristic species and others not so well known.

From the Western plains we have lately received two species wholly unlike any examples in our possession, and which seem to us quite different from any of the species described in Dr. De Toni's monograph. We figure and characterize them as follows:

1. *Geaster campestris* Morg. (Fig. 1).—Outer peridium thick, multifid; the segments (eight to ten) reflexed, whitish below, rufescent within. Inner peridium globose, subpedicellate, verru-

cose, gray, or brownish, the mouth conic, sulcate-plicate, in a circular, marginate disk. Spores globose, verruculose, brown, .0055–.007 mm. in diameter.

Growing in clusters, at first half immersed in the soil, on the open prairie about Lincoln, Neb. Sent by Prof. Charles E. Bessey.

FIG. 1.

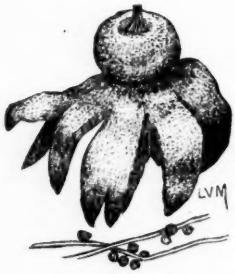
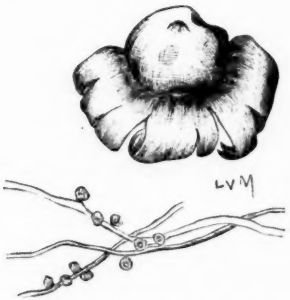


FIG. 2.



Inner peridium three-eighths to three-fourths of an inch in diameter, the expanded segments one to two inches. The outer peridium is concave or vaulted underneath, with the segments often inflexed at the tip, as in *G. bryantii* and *G. limbatus;* it also has the same fibrillose stratum beneath binding it to the soil; when this is cleared away it leaves a smooth, whitish outer surface. In most of the dried specimens the inner peridium is distinctly pedicellate. The peculiar feature of this species, however, is the minute, scaly or granulose warts which invest the surface of the inner peridium; there is no other species with a similar surface, unless it be the *G. granulosus* Fuckel, which is described as "covered with a white granulose powder." Moreover, it has a filamentous peristome, and belongs among the *Fimbriati,* while our species belongs to the *Striati* of Dr. De Toni's arrangement.

2. *Geaster delicatus* Morg. (Fig. 2).—Outer peridium thin, multifid; the segments (six to ten) unequal, revolute, whitish below, alutaceous within. Inner peridium depressed-globose, sessile, puberulent, pallid; the mouth lacerate. Spores globose, verruculose, fuscous, .005–.006 mm. in diameter.

Growing on the prairie around Lincoln, Neb. Sent by Prof. Charles E. Bessey.

Inner peridium one-fourth to one-half of an inch in diameter, the expanded segments an inch or more. The segments, when fresh or wet, are strongly revolute, and become inflexed when dry, after the manner of *G. hygrometricus;* they are nearly papyraceous, the inner, fleshy stratum being remarkably thin; the color outside is whitish or glaucous, and the external surface is

very smooth. There is no determinate circular areola to the inner peridium and the mouth is stellately lacerate or sometimes a mere slit or puncture. The nearest relative would appear to be *G. bovista* Klotsch, from which it differs in several particulars; it belongs to the same section, the *Exareolati*, of Dr. De Toni's monograph.—*A. P. Morgan, Preston, Ohio.*

ENTOMOLOGY.[1]

Observations of Portchinski on Flies which, in their Larva Stage, cause Diseases among Men and Animals.—Baron Osten Sacken gives[2] an account of some publications of Mr. Portchinski, from which we extract the following, as of general interest:

For many years past Mr. Joseph Portchinski (at present secretary of the Entomological Society in St. Petersburg) has been devoting a great deal of time to the study of the life-habits of carnivorous and coprophagous larvæ of Muscidæ, and several valuable publications on that subject are due to his pen already. But as most of these publications are written in Russian, they have remained less known than they deserve. Several of them, however, have appeared in German in the *Horæ Soc. Ent. Ross.*, and two of these are on the subject indicated in the heading to this extract.

The principal result which science owes to these papers is the elucidation of the history of *Sarcophila wohlfahrti* as a dangerous but hitherto unrecognized enemy of men and animals, the European substitute of the celebrated *Lucilia macellaria* (syn. *L. hominivorax*) of America. In 1768, Dr. Johann August Wohlfahrt, physician in Halle, published a paper ("Observatio de Vermibus per Nares excretis") describing a case where peculiar worms in the nose of an old man produced intolerable headache, and almost drove him to madness. Wohlfahrt succeeded in breeding the fly of these larvæ, and gave a description, accompanied with figures sufficient for the recognition of the species. Numerous similar cases have been observed since, and either altogether misunderstood or else ascribed to different other species of common carnivorous flies,—species of *Sarcophaga, Lucilia, Calliphora.* To Mr. Portchinski belongs the merit of having pointed out that the great majority of the cases of the *Malum verminosum* observed on men and animals are produced by that particular species, described more than a century ago by Wohlfahrt, and so far overlooked since, owing probably to its close resemblance to other species, that it was described for the first time by Schiner in 1862 only, who had no idea of its

[1] This department is edited by Prof. J. H. COMSTOCK, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Berliner Entomolog. Zeitschrift, Bd. xxxi. p. 17.

dangerous propensities, nor of its identity with the species described but not named by Wohlfahrt. Mr. Portchinski shows that *S. wohlfahrti* occurs all over Europe, that it attacks animals, domestic and wild, and that occasionally it causes horrible sufferings and even death among men. In the work of Dr. Megnin, "Les Parasites et les Maladies parasitaires," Paris, 1880, the author acknowledges Mr. Portchinski's conclusions, and says that every time he succeeded in breeding the fly from such larvæ it was the *Sarcophila wohlfahrti* which escaped from the pupa.

Lack of Parallelism between the Characters of Larvæ and Adults.—"The new article of Mr. Portchinski, 'Comparative Biology of the Necrophagous and Coprophagous Larvæ,'[1] brings us a series of important observations, and illustrates the wonderful power of adaptation of these larvæ to their environment,—an adaptation which, in a certain measure, destroys the parallelism which we naturally expect to exist between the systematic characters of larva and imago. Such apparent want of parallelism has been observed in the order Diptera before, but an abundance of new facts are found in Mr. Portchinski's paper. Distantly-related species, belonging to different genera, issue from larvæ almost undistinguishable from each other; and, again, closely-related and almost undistinguishable imagos, species of the same genus, differ in their oviposition (size and number of eggs), and their larvæ follow a different law of development (as to the degree of maturity the larva reaches within the body of the mother, and the number of stages of development it passes through). In one case even (*Musca carvina*) larvæ of the same species were found to have a different mode of development in northern and southern regions." (Osten-Lacken, *l. c.*)

The Colorado Potato-Beetle in Europe.—The Colorado potato-beetle has appeared in large numbers upon the potato-fields of Malitzsch, a village near Dommitzsch, in Saxony. It is believed, from the abundance of the beetles, that the species must have been introduced into that locality several years ago. The Prussian government is taking vigorous measures to exterminate the pest.

Recent Publications.—Among the recent publications upon our table are two systematic works which are worthy of more than a passing notice. One of these is a "Synopsis of the North American Syrphidæ," by Dr. S. W. Williston. This constitutes Bulletin No. 31 of the United States National Museum. It is an octavo of three hundred and sixty-four pages. It contains full descriptions of all our species,—about three hundred in number. In the introduction there are given synoptic tables of

[1] Horæ Soc. Ent. Ross., vol. xix. pp. 210–244.

the tribes and genera; and in the body of the work each generic description is followed by a table of the species when the genus contains more than one.

The second of these systematic works is "A Monograph of the Aphodiini inhabiting the United States," by Dr. George H. Horn.[1] In this monograph eighty-two species are enumerated. Each species is fully described, and synoptic tables for separating them are given. The work is done in the careful manner characteristic of Dr. Horn's writings. It is based on practically a complete series of specimens. Only two of the species are unknown to Dr. Horn, and all but four are in his cabinet. The descriptions are so definite that specimens can be determined from them with certainty.

From the Department of Agriculture at Washington we have received the annual report for 1886, containing the report of Dr. Riley as entomologist; and from the same source we have received Bulletins Nos. 13, 14, and 15 of the Division of Entomology. The more important of the topics discussed in these reports are the following: "The Cottony Cushion-Scale," which is doing great injury in California; "The Southern Buffalo-Gnat," "The Fall Web-Worm," and "Insects Injurious to Wheat."

A considerable amount of literature on the *Coccidæ* has appeared recently. In addition to Dr. Riley's reports on the Cottony Cushion-Scale, Miss Ormerod publishes a pamphlet on the same insect, entitled "Notes on the 'Australian Bug' in South Africa." In the *Transactions of the New Zealand Institute* Mr. Maskell publishes an article "On the 'Honeydew' of Coccidæ and the Fungus accompanying these Insects," and from the press of the Government Printer at Wellington there has just been issued a volume by Mr. Maskell on the "Scale Insects of New Zealand." This is illustrated by twenty-three plates, nearly all of which are colored.

In Bulletin No. 2 of the State Entomologist of Illinois Professor Forbes treats of "The Present Condition and Prospects of the Chinch-Bug in Illinois."

ZOOLOGY.

Sense Organs of Turbellarians.—Dr. L. Böhring has recently published (*Zool. Anzeiger*, 260) a preliminary account of the eyes, etc., of several species of planarians. In *Planaria gonocephala* each eye consists of a nervous apparatus and a pigment-layer, and the latter, unlike the eyes of Lang's Polyclada, consists of many nucleated cells united. The cavity of this pigment-layer is filled with end organs, each of which has a complicated structure, though this whole apparatus has previously been described

[1] Trans. Am. Ent. Soc., vol. xiv. p. 1–110.

as a hyaline, structureless formation. Each end organ connects with a nerve-fibre, which in turn leads back to a unipolar cell of the optic ganglion. No lens is to be recognized in the sections. In *Vorticerus auriculatus* the two eyes (which lie directly on the brain) have the optic cavity divided into two chambers by a middle pigmented wall. Each cavity is filled by fine rods, leaving a central canal free. Around the margin of the capsule are numerous cells, which resemble ganglion-cells, and which send fibres to the rods, and hence are regarded as retina-cells.

A Parasitic Rotifer.—Nearly twenty years ago E. Ray Lankester briefly described and roughly figured a rotifer, which he found parasitic in the body-cavity of Synapta from the Island of Guernsey. Recently Dr. Zelinka has found the same form in the Adriatic, and describes it as *Discopus synaptæ* nov.-gen. et sp. According to the latter author this is not an endo-parasite, but lives in folds of the skin of the Synapta, and from these large numbers may be taken by a pipette. The animal belongs to the Philodinidæ. Zelinka has been able to stain and section these animals, and describes their internal structure in some detail. His conclusions are (1) that the bilobed wheel of the Philodinidæ can be homologized with the ciliated band of the trochosphere, (2) that the anterior end of the outstretched body is homologous with the "scheitelplatte," and (3) that the brain of the rotifer arises partly from separation from the scheitelplatte, and partly from immigration of primitively peripheral ganglion-cells.

The Genus Sesarma.—In 1818 Thomas Say described the genus *Sesarma* for a Floridan species of crab belonging to the Grapsoid group. Since that time numerous other species of the same genus have been described from all parts of the world, the latest list embracing seventy-one nominal species, the limits and synonymy of which are in almost inextricable confusion. Lately (*Zoologische Jahrbuch*, ii. 1887) Dr. J. G. de Man has attacked the Indo-Pacific species of the genus, and introduced some order into their classification. He divides the genus into four groups, based upon the character of the upper margin of the hand and the teeth of the margin of the carapax. He also regards the genus *Sarmatium* of Dana as of sub-generic value. In the same paper he further includes the results of a study of the Crustacean types of Hess and Nauck, by which a large number of nominal genera and species are thrown into synonymy.

Preliminary Notes on the Osteology of Alosa sapidissima.—In the shad the muscle of the lateral line is very largely developed, and extends down quite deeply between the dorsal and ventral masses of the lateral muscles. In the connective tissue

between the segments of the muscle of the lateral line a series of vertical cartilaginous plates are developed, extending backward and outward. They are irregularly triangular in outline, and the apex of the triangle, which is directed forward and inward, overlaps the distal extremity of the epicentrale. These cartilages seem to be evidence that a process of differentiation is going on in the shad similar to that which resulted in the differentiation of the sense organs of the head, and give support to the theory that these are derived from integumentary sense organs allied to those of the lateral line.

A consideration of their relation to the other skeletal elements of the abdominal segments suggests that the foremost visceral arches are not homologous with the branchial arches, but may belong to a series including the extra-branchials of Parker, the scapula portion of the pectoral arch, and the epipleurals.

They also suggest an origin for the free portion of the paired limbs from a ventro-lateral series of sensory organs, similar to those seen in amphibian larvæ which lie in a line connecting the fore and hind limbs.

Such a development might afford some explanation of the cephalic fin present in some elasmobranch fish either as a survival, or a reversion.—*Fanny R. M. Hitchcock.*

To the Editors of the Naturalist:

Sirs,—Owing to the failure of the corrected revise to reach the publishers, my article, "Remarks on Classification," in the October number, requires some comment:

1. On page 915, last paragraph, the words *neither tubular nor even grooved* should be *never tubular.*

2. Near the bottom of the Table, the equivalent of Stereoneura should be "*invertebrates*"—*tunicates.*

3. At about the middle of the Table, under Monocœlia and Polycœlia, the words *axon unsegmented* and *axon vertebrated* should be omitted.

4. On page 915, in the last line of the second paragraph, *will* should be *may.*

5. In several places the words *centre* and *synonyme* should be *center* and *synonym.* While the forms imposed by the publishers are sanctioned by Worcester, I prefer to follow Webster, as with *pseudonym, theater, meter,* etc. So long, indeed, as these two words and *center* are pronounced by all English speakers in two syllables, there seems to be no more reason for retaining the French orthography than in the case of *chambre,* which is always Anglicized as *chamber.* Burt G. Wilder.

Ithaca, N. Y., October 29, 1887.

Zoological News.—Cœlenterates.—Mr. Richard Rathbun catalogues, with notes, the species of the genus Madrepora in

the United States National Museum. This collection is rich in type specimens of corals, containing, as it does, those which formed the bases of both Dana's and Verrill's descriptions of two large American exploring expeditions. In all fifty-nine species are enumerated. Later in the same volume he does the same work for the species of Porites and Synaræa. Twenty-three species of Porites (including *P. branneri* nov.) and three of Synaræa are included.

WORMS.—Fletcher and Hamilton describe, in a recent paper, fourteen new species of Land Planarians from Australia. Some of these have two eyes, and are referred to Leidy's genus Rhynchodemus. Some of their specimens agree well with species belonging to Moseley's genus Cænoplana, except that they have well-developed eyes,—a fact which leads them to regard that genus as synonymous with Geoplana.

VERTEBRATES.—Dr. Giglioli, of the Royal Museum of Florence, describes (*Zool. Anzeiger*, No. 261) a new species of Cercopithecus from Central Africa. It belongs to Schlegel's sixth group of the genus, and is allied to *C. leucampyx*, etc. It is named *C. boutourlinii.*

In the same journal (*Zool. Anzeiger*, No. 261) Dr. C. Zelinka notices a strange instance of batrachian teratology. In the urinary bladder of a specimen of *Salamandra maculata* he found a normal larva of the same species, pigmented, and two and one-half centimetres in length.

Mr. Charles H. Townsend contributes a series of valuable field-notes on the mammals, birds, and reptiles of Northern California to the *Proceedings U. S. National Mus.* for 1887. Among the more important points brought out are notes on the teratology of the antlers of *Cariacus columbianus*, and on the habits of the porcupine. He says that skunks killed as directed by Baird—caught in a box-trap and drowned—do not discharge their fluid as when killed in other ways.

F. W. True describes a new bat (*Vespertilio longicrus*) from Puget Sound in the *Proc. Nat. Mus.* for 1887, and in the same place gives cranial characters which he regards as distinctive of the Canada lynx.

Jordan and Evermann give a review of the food-fishes of Indiana in the last Agricultural Report of that State. Out of the hundred and fifty species but about fifty ever appear in the markets as food-fishes. The lake-sturgeon is said to spawn in the rivers in June, the red-horse in May,—points of interest to those who are studying Teleost embryology.

Francis Day describes (*Proc. Zool. Soc. London*, 1887) a supposed hybrid between the pilchard and the herring, the scales and coloring of the two sides of the body presenting the characters of each of the parent species respectively. The same

author has a paper on the Loch Leven trout in the *Journal of the Linnean Society* for this year. He does not, however, come to any decision as to the specific validity of the form in question.

Prof. E. D. Cope describes (*Proc. U. S. Nat. Mus.*, 1887) a new species of Tropidonotus, from Washington, D. C., under the name *T. bisectus*. In its affinities it is nearest to *T. woodhousei*, and the fact that it occurred in a region so carefully studied lends plausibility to the view that it is an introduced species.

Dr. van Lidth de Jeude contributes some notes on a collection of fishes and reptiles from the West Indies to vol. x. of the Leyden Museum *Notes*. The new species described are *Gymnodactylus antillensis*, *Phyllodactylus martini* (= *P. julieni* Cope), *Cnemidophorus arubensis*, *Crotalus horridus* var. *unicolor*, *Pœcelia vandepolli*, and same var. *arubensis*. A larger acquaintance with American literature would have reduced the number of nominally new species.

EMBRYOLOGY.[1]

Development of the Cœcilians (*Ichthyophis glutinosus*).[2]—The remarkable discoveries of the brothers Sarasin during their sojourn in Ceylon are now in course of publication, and promise to clear up some very important questions in morphology and taxonomy. This is the case with the memoir before us.

After surmounting many discouraging difficulties, the Sarasins have succeeded in presenting a pretty full account of the development of the remarkable, worm-like, limbless salamanders of the genus *Ichthyophis*. The ova are laid in strings, joined together by continuations of the egg-membrane, so as to remind one of a string of beads. The individual ova are quite large, or nearly the size of a marrow-fat pea. There is a considerable albuminous investment to each ovum, and at the points where the ova are joined together there is a well-defined chalaza developed at opposite poles, these chalazæ seeming to join adjacent ova together through the narrow tubular connections formed by their common coverings. The female guards her ova in a burrow, and not the least charming feature of this memoir is the skill with which the famous zoological artist Mützel has succeeded in giving a most spirited rendering of the animal in its burrow coiled about its ova. This effective picture has been composed from photographs taken from life by the authors.

On account of the very large size of the ovum the mode of development differs very considerably from that of other Amphibia, in that a very distinct blastoderm is formed, which slowly invests by epiboly the underlying yelk, as in Elasmobranchs, Reptilia, Teleostei, and Aves. The formation of the embryo

[1] Edited by JOHN A. RYDER, Ph.D., Biological Department, University of Pennsylvania.

[2] Ergebnisse naturwissenschaftlicher Forschungen auf Ceylon. Heft II., 4to. Wiesbaden, 1887. Kreidel.

and the method of infolding of the medullary groove is, however, characteristically amphibian. At the posterior end of the embryonic area the furrows characteristic of the Amphibia appear. As segmentation proceeds, the yelk-granules are taken up into the cells of the blastoderm as they are into the cells of the embryo in other Amphibia, and in Petromyzon, as I am informed by Prof. Scott, of Princeton.

The cranial flexure is profound, and at times the head is well differentiated, the branchial clefts and visceral arches are developed with great distinctness, so that from the side the head presents, at this stage, an appearance which is decidedly like that of an embryo of a bird or a mammal. The last remnants of the yelk are not absorbed below the cardiac region as in Teleosts, but the yelk-sac is carried far back, so as to occupy a position in front of the vent. In this respect there is a resemblance to the mode in which the last remnant of the yelk is absorbed in the Marsipobranchs, on which account the writer has called the latter *opisthotrophous* in reference to this peculiarity. The embryo is also folded off from the yelk somewhat in the same manner as in Marsipobranchs, the head first becoming free and then the trunk. There is a very distinct vascular net-work formed over the yelk at a late stage, much as in *Alytes*, as described by C. Vogt many years ago.

The embryo also becomes coiled up in the ovum, and then, some time before its escape from the egg, three beautiful plumose or pinnate branchial processes grow out from either side in the region of the posterior branchial clefts. These are compared with the plumose branchiæ of the larvæ of *Megalobatrachus japonicus* from Japanese figures. An amended figure of the larva of *Typhlonectes compressicauda*, another Cœcilian, is also given, and the account of Peters, which was based on the same material, corrected. The Sarasins find that the single pair of branchiæ in *Typhlonectes* are not vesicular, as supposed by Peters, but leaf-like.

Another singular feature which the memoir reveals is the presence of vertical tail-folds on the tail of the larvæ of Ichthyophis; these extend forward to the vent, and back over the end of the tail, and forward over the dorsal side a little in advance of a vertical line from the anus.

Still more remarkable is the development of a pair of rudimentary limb-buds, representing the hind limbs, on either side of the vent, or cloaca. These afterwards undergo a retrogressive metamorphosis. The occurrence of a vertical tail-fold in the larva of Ichthyophis reminds one of the development of such structures in adult Urodeles, such as Triton, while the abortive limb-buds prove beyond question that these singularly modified burrowing and worm-like amphibians are undoubtedly descended from types which possessed well-developed ambulatory organs, as proposed by Cope.

The Origin of the Segmental Duct in Elasmobranchs.[1]—J. Beard, in a note in the publication cited, finds that in *Scyllium* and *Torpedo* the segmental duct is of epiblastic origin, as previously determined by Hensen and Flemming in the rabbit, Spee in the guinea-pig, Van Wijhe in the skate, J. von Perenyi in *Rana esculenta* and *Lacerta viridis*. Beard concludes his note with the presentation of a view almost identically the same as that previously urged by Haddon, to whom he, in fact, in a postscript, gives the credit of having been the first to suggest the origin of the segmental ducts and the establishment of their connection with the cloaca, as given in an abstract of Professor Haddon's paper, given in a recent number of this journal.

The Vestiges of a Zonary Decidua in the Mouse.—An account of some researches on this subject was given in the August number of this journal by the editor of this department. Since then, my assistant, Mr. Geo. Fetterolf, has prepared sections of some of the material in my possession, cut in such planes as to display the relations of the parts involved very clearly.

I find that the at first greatly thickened portion of the mucous membrane in the region of the embryos undergoes some very marked changes. At first the mucosa thickens very much around the embryo. This thickening forms a ring of tissue around the blastodermic vesicle. The only portion of this ring which persists is that which lies in the vicinity or on the site where the discoidal placenta is subsequently formed. The portions of the thickened ring of the mucous membrane on the side opposite the placenta and at the sides of the blastodermic vesicle are absorbed, as sections through the uterus and fœtus of a later stage prove. The hoop-like thickening which is continued from opposite sides of the placental region, and which encircles the fœtus and its membranes, is, as assumed in my previous note, nothing more or less than the transitory representative of a zonary or girdle-like decidua, all traces of which are lost before the end of fœtal life.

The mode in which this hypertrophied portion or annular band of the mucosa is absorbed is highly interesting. In the intermediate stages, at either side of the discoidal placenta and just where the maternal tissue of the placenta is continued into what was formerly the much thickened, but now nearly absorbed ring of thickened mucous membrane, there are found groups of huge cytoclasts or phagocytes, which are evidently the agents in the destructive metamorphosis of the abortive portion of the mucosa which has proceeded only a little way towards the formation of a zonary placenta. The presence of abortive villi on the surface of the chorion in the vicinity is a further proof of

[1] Anatomischer Anzeiger, ii., No. 21, p. 646, 1887.

this. The area of the *chorion frondosum* is very small, not over one-fourth of the area of the under side of the placental disk. The portion of the chorion underlying the placental disk, but not united with it, belongs to the *chorion læve*, and its abortive villosities even extend over and are developed on its surface somewhat beyond the edge of the placental disk.

The cytoclasts spoken of above are many times the size of any of the rest of the cells found in the uterus, fœtus, or fœtal membranes, and they also possess very large nuclei. The processes of adjacent cytoclasts spoken of frequently join, and there is thus formed a sort of syncytium. This syncytial structure, if isolated, would form a ring composed of cytoclasts just at the edge of the placenta, and is especially developed at about the time the zonary band of mucous membrane around the fœtus is nearly absorbed.

These data furnish further proof that the primitive or ancestral type of placentation was a more diffuse one than in existing Rodents of the myomorph type, and throws some additional light on the manner in which a discoidal type of placentation has been derived from one which was zonary.—*J. A. Ryder.*

PSYCHOLOGY.

On Duration of Memory in Wasps.—In studying the psychology of insects, it is noteworthy that we have very little satisfactory evidence with regard to duration of memory. Belt's observation on leaf-cutting ants, which tends to show recollection of a locality for one year, is by no means conclusive, as the facts are as well, if not better explained by supposing that the ants accidentally stumbled upon the old vacant nest. Also with bees, the observations of both Stickney and Huber are inconclusive. Stickney's evidence on the subject, as given by Romanes,[1] is as follows:

"Stickney relates a case in which some bees took possession of a hollow place beneath a roof, and having been then removed into a hive, continued for several years to return and occupy the same hole with their successive swarms."

It would be hardly safe to conclude that bees have extended powers of memory from so indefinite an account as this.

Again we quote from Romanes:[2]

"Similarly Huber relates an observation of his own, showing the duration of memory in bees. One autumn he put some honey in a window, which the bees visited in large numbers. During the winter the honey was taken away and the shutters shut. When they were again opened in the spring, the bees returned, although there was no honey in the window."

The obvious criticism is that we have no evidence that the

[1] Animal Intelligence, p. 154. [2] L. c., p. 155.

bees that came in the spring were identical with those that came in the preceding autumn, it being possible, and indeed probable, that they visited the window in the second case, as they did in the first, by accident.

The facts which we have already published with regard to the recollection of the properties of glass by hornets[1] suggest, but scarcely establish, a memory of ten or twelve days' duration. Sir John Lubbock's observations demonstrate that bees remember for at least one day a locality in which they have found honey, but we recall no experiment, not open to serious objections, that tends to prove for ants, bees, or wasps a duration of memory greater than twenty-four hours.

The small number of published facts on this subject led us to make an attempt, during the past summer, to obtain some definite data as to the duration of memory in wasps. With this end in view, on August 18, we took from a nest of *Vespa maculata* forty-three wasps, imprisoning them in a large wire cage, and feeding them with apples. We kept them until August 20. Unfortunately, all died but seven. We marked these by a cut on the right upper wing, and set them free at a distance of thirty yards from the nest. They flew in various directions.

On August 22 we took forty wasps from the nest. These we carefully protected from cold at night. We fed them on apples and apple-jelly. Owing, probably, to the better care they kept strong and energetic.

On August 25 we liberated seventeen, marked by a cut on the left upper wing, thirty-five yards from the nest. The majority of these flew towards the nest. A few settled on the ground.

On August 26 we liberated thirteen, with both upper wings cut, thirty-five yards from the nest. They seemed to be in fairly good condition, and flew in various directions, several of them settling near us on the ground.

On August 27 we took seventy wasps from the nest, and gave them every care and attention, intending to keep them out for five or six days. They died in such numbers, however, that on August 29 we took the survivors, eight in number, and, after marking them with a V cut on one wing, set them free at a distance of two hundred and sixteen yards from the nest. Most of these settled near by. A few flew towards the nest.

Having stopped the entrance on the evening of August 29, on the morning of the 30th we poured a solution of cyanide of potassium into the nest, killing all the inhabitants. We then examined the dead wasps, one by one, to determinine how many of those that we had marked and liberated had returned to the nest. The result was as follows:

Of seven which had been retained fifty hours and were liber-

[1] Proceedings of the Natural History Society of Wisconsin, pp. 121–22.

ated thirty yards from the nest, we found five. Of seventeen which had been retained seventy-two hours and were liberated thirty-five yards from the nest, we found eleven. Of thirteen which had been retained ninety-six hours and were liberated thirty-five yards from the nest, we found six. Of eight which had been retained forty-nine hours and were liberated two hundred and sixteen yards from the nest, we found none. It thus appears that wasps remember the locality of their nests for ninety-six hours.

We had hoped to collect a much larger store of facts upon this subject, but were prevented from doing so by the difficulty of keeping the wasps alive after we had taken them from the nest, and by a lack of material to work upon. We were able to find only one wasp-nest during the entire summer, although in the summer of the year before we had found thirty-three nests in the same neighborhood.

Our strictures upon the observations of others may seem hypercritical, but when it is remembered that the only warrant for making any inference whatever is based upon the supposition that a similarity in the actions of insects to those of man, under a given set of circumstances, is the result of a similarity in their mental processes, it will seem scarcely possible to be too guarded in drawing conclusions.—*G. W. and E. G. Peckham.*

MICROSCOPY.[1]

Microtechnical Notes by Dr. Paul Mayer.—After describing the new water-bath and its accessories, Dr. Mayer proceeds to give the latest improvements in the methods employed at the Naples Zoological Station:

1. *The Section-Smoother, or Planisher.*[2]—The rod of the schnittstrecker, or planisher, as I shall call it, is not large enough to prevent very large sections from rolling a little. The defect is easily remedied by following the example of Vosmaer, who cuts off strips of the gelatin plates used by lithographers for tracing, and fastens them to the under side of the rod with very soft paraffine. In this manner the rod can readily be enlarged to any desired extent; and the transparency of the gelatin makes it possible to follow the sections as they pass under the rod.

2. *Section-Fixatives.*—Of the three fixatives now in general use,—shellac, collodion, and albumen,—shellac is considered the

[1] Edited by C. O. WHITMAN, Ph.D., Milwaukee, Wisconsin.

[2] "Schnittstrecker" has been variously translated "section-smoother," "section-stretcher," "section-flattener," etc. Perhaps the German name has been poorly chosen; at all events, our renderings of it are decidedly unsatisfactory names. The instrument is designed to prevent sections from curling; in other words, *to keep them plane*, or flat. The word *planisher*, taken in a strictly etymological sense, expresses the idea precisely enough, is both simple and intelligible. I venture, therefore, to propose it as a substitute for the awkward and clumsy compounds hitherto employed.

best for objects colored *in toto*. The carbolic-acid shellac introduced by Mayer has been found to be unreliable in some respects. Carbolic acid warm is injurious to some tissues,—*e.g.*, the dermis of vertebrates. The alcoholic solution is a perfectly harmless fixative. The method of using, which differs in important points from the one prescribed by Giesbrecht, is as follows:

a. The object-slide, heated to about 50° C., is coated with shellac in the usual manner, by drawing a glass rod wet with the solution once or twice over its surface. As soon as the slide is cool and the film of shellac hard and no longer sticky, the sections are arranged dry, and then gently pressed down by means of an elastic spatula (horn or metal) until they lie flat and smooth on the slide.

b. Expose the slide thus prepared to the vapor of ether. For this purpose the slide may be placed in a glass cylinder of suitable size, and closely stoppered. The cylinder is placed in a horizontal position, or, at least, so inclined that the slide lies wholly above the ether. The saturation of the sections will be sufficiently complete in about half a minute.

c. The slide is next to be warmed in the water-bath in order to evaporate the ether. The paraffine is then removed and the mounting completed in the usual manner.

It is best to use balsam dissolved in turpentine or benzole rather than in chloroform, as the latter softens the shellac, and thus often loosens the sections.

One great advantage of this method of using shellac is that it permits of *arranging and flattening the sections on the slide.* Ordinarily sections are placed while the adhesive coating is soft, and must then lie as they fall.

With reference to collodion, Mayer remarks that it depends entirely upon the *quality* of the gun-cotton employed whether the sections bear well treatment with alcohol and aqueous fluids. When sections are to be stained on the slide, the albumen-fixative is preferred to collodion. This mixture is prepared as follows:

White of egg	50 grm.
Glycerin	50 "
Sodium salicylate	1 "

These ingredients are mixed and thoroughly shaken together, then filtered and kept in a well-cleaned bottle. Mayer has kept this mixture three years in a good condition. Other antiseptics have proved far less efficient than salicylate of sodium.

3. *Sublimate.*—For the extraction of sublimate from tissues Mayer employs tincture of iodine. The tincture is added in small quantities to the alcohol in which the objects are preserved, as often as the color fades.

4. *Mayer's Carmine.*—This staining-fluid, previously described as "Alcohol Carmine,"[1] is a modification of Grenacher's acid carmine.

Carmine	4 grm.
Water	15 c.cm.
Hydrochloric acid	30 drops.
Alcohol (85 %)	95 c.cm.
Ammonia (enough to neutralize).	

The pulverized carmine is mixed with the water and the acid, and dissolved by boiling. The alcohol is then added, and the solution neutralized by stirring in ammonia until a precipitate begins to appear. This method of procedure is safer than the one hitherto followed, according to which the carmine was dissolved by boiling in the alcohol plus the acid.

5. *The Latest Camera Lucida of Abbe.*[2]—Zeiss makes two forms of the new Abbe camera lucida. Both are constructed on the same principle, but one (No. 70) has a larger mirror and a longer arm than the other (No. 69). The larger form—the one recommended by Dr. Mayer—is only made to order. The advantage of this form is that it enables one *to utilize the whole field of vision without any perceptible distortion of the image*, and is thus especially useful in drawing comparatively large objects with low powers. With the smaller camera (No. 69) the whole field can be projected on the drawing-paper only by giving the mirror an inclination differing so much from the angle (45°) required for accurate drawing that the image is more or less disproportioned.

The Abbe camera is superior to that of Oberhäuser in two important particulars: it gives a much larger field of vision and better light. Its construction does not admit of use with the microscope-tube in a horizontal position. This is a defect which ought to be at once corrected.

The Abbe cameras, especially the larger one, can be used to great advantage with the embryograph of His. It is only necessary to add to the stand a horizontal arm, to which the camera can be fastened.

The construction of the Abbe camera is illustrated in the accompanying cut.

The drawing-surface is made visible by a double reflection from a large plane mirror, and from the silvered surface of a small prism in the visual point of the eye-piece. The microscopic image is seen directly through an apparatus in the silvering of the prism. By the concentricity thus obtained of the bundle of rays reaching the eye from both the microscope and the paper, the image and pencil are seen coincidently without any straining of the eyes. With this apparatus, moreover, draw-

[1] Whitman, Methods of Research, etc., p. 39.
[2] Zeiss's Catalogue, 1885, p. 44, No. 70.

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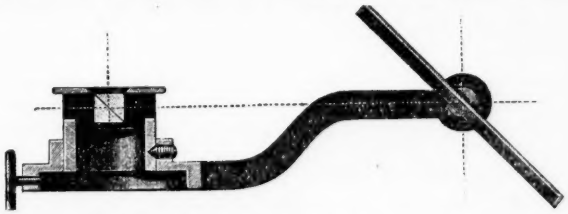

tinted glasses which fit into the prism mounting. The apparatus is specially adjusted for the No. 2 Huyghenian eye-piece; mounted on this and fixed by a clamping screw the mirror only requires turning in the proper position and it is then ready for use.

SCIENTIFIC NEWS.

The Proposed Monument to Audubon.—At the recent meeting in New York of the American Association for the Advancement of Science, the fact that the remains of the great naturalist, Audubon, lie in an obscure and little-visited portion of Trinity Cemetery, New York City, and that his tomb is unmarked by any distinguishing monument, was brought to the attention of the members. The demands upon the time of all in attendance at that meeting were so great that no action was taken by the Association, although the most lively interest was expressed by individual members, and the propriety of marking the resting-place of the founder of American Ornithology by a suitable monument was appreciated.

The Audubon plot in Trinity Cemetery will probably be disturbed by the continuation westward of One Hundred and Fifty-third Street. The trustees of the cemetery have, with commendable liberality, assigned the Audubon family a new lot close to One Hundred and Fifty-fifth Street, in full sight of Audubon Park and near the end of Audubon Avenue, when this shall be continued from the north, and are in hearty co-operation with the monument enterprise.

At the first autumn meeting of the New York Academy of Sciences a committee was appointed to solicit funds and make all arrangements for a monument.

Vice-President Trowbridge then appointed as such committee Prof. Thomas Egleston, of the School of Mines, Chairman, Prof. Daniel S. Martin, of Rutgers Female College, and Dr. N. L. Britton, of Columbia College. This committee has organ-

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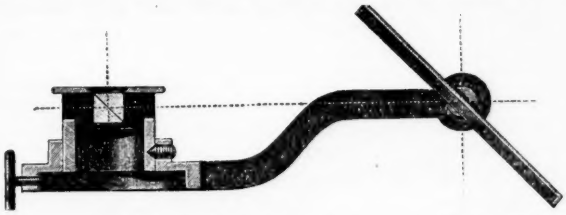

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ized with Dr. Britton as secretary and treasurer, and is now ready to receive subscriptions, which will be properly acknowledged. Checks should be made payable to N. L. Britton, Treasurer, and post-office orders should be drawn on Station H, New York City.

The committee estimates that between six and ten thousand dollars will be required to erect and engrave a shaft worthy the memory of America's first naturalist, and, while confident that this amount will be forthcoming, desires to have interest taken in the project by scientists in all departments in all portions of the country.

—Prof. A. H. Worthen has recently secured by purchase for the State Museum of Illinois four collections of Carboniferous fish teeth and spines, aggregating about two thousand specimens, which probably cannot be duplicated on this continent. It will be arranged for exhibition in the course of two or three months.

—Dr. M. E. Wadsworth has resigned the professorship of mineralogy and geology in Colby University, and has accepted the directorship of the Michigan Mining School. His address now is Houghton, Michigan, U. S. A. Exchanges are especially desired of papers relating to general and technical education, petrography, general and economic geology, mineralogy, crystallography, and meteorites.

—Professor Forbes's address, "The Lake as a Microcosm," has been printed in the *Bulletin of the Peoria Scientific Society* for 1887. In it are given generalizations based upon Dr. Forbes's investigations of the lakes of Illinois and Wisconsin.

—Prof. A. F. Marion, of Marseilles, has been elected a corresponding member of the Department of Anatomy and Zoology of the Academy of Science at Paris.

—Dr. H. Mayr, of Munich, has been appointed to the professorship of botany in the University of Tokio.

—Dr. Oscar Hertwig has been appointed ordinary professor of anatomy at Berlin, and Dr. G. Volkens has become a privatdocent in botany in the same university.

—Dr. A. Vöchting, of Basle, goes to the chair of botany in Tübingen.

—Recent Deaths.—Olry Terquem, student of Foraminifera, at Passy, aged ninety years; Dr. G. Grewink, Professor of Mineralogy at Dorpat, June 30, 1887, aged sixty-nine; Prof. L. G. de Koninck, the veteran palæontologist, at Lüttich, July 15, aged seventy-nine; Julius von Haast, the New Zealand geologist, aged sixty-two years.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—September 10, 1887.—Mr. Wm. T. Davis presented the following entomological notes: A little over a year ago, on July 3, while sitting on the piazza in the evening, I saw a *Calosoma scrutator* running across the floor. After a time it came to a stand-still and, lowering its body (for this beetle ordinarily carries it rather high), beat its antennæ, particularly the left one, rapidly on the boards. This made quite a loud, whirring noise that could have been heard many feet distant. I was sitting about two yards away from the insect, and it was very plain to me. I approached cautiously and watched it repeat the operation several times, but it finally ran to the edge of the piazza and flew off into the grass. A proceeding of this kind on the part of an insect is always interesting, as it indicates some mental activity. I have endeavored to make further observations on the subject, but no Calosoma in the proper frame of mind has yet afforded an opportunity.

On June 22 of this year I captured a female *Hyperchiria Io*, and, wishing to get some eggs, I put her in an old hat-box, thinking she would lay them there. There was, however, quite a small hole in the side of the box, and the moth, putting her body through it, laid all the eggs on the outside, thus choosing the lightest situation instead of the dark interior. The most amusing trait of the young caterpillars of this species is the soldier-like way in which they follow one another. I have watched them walking along a branch, the leader turning about when still some distance from the end, and all those behind uniformly followed that course, turning at the very same point.

In the Proceedings for October, 1885, I gave an account of how a chrysalis of the Monarch butterfly developed while pierced by a pin, the imago appearing in due time. I have since pierced some chrysalids of the cabbage-butterfly (*Pieris rapæ*), and they also brought forth perfect insects. One of these insects, when hatched, had the pin through the thorax as if transfixed in the perfect state. Of course, they are badly deformed, but it goes to prove what injuries may be inflicted upon them in nature, and they yet survive.

Two specimens of these butterflies were exhibited.

A preliminary list of the crustaceans of the island was presented by Mr. Ernest A. Congdon; also a list of the marine algæ from the shores of the island, by Mr. Nicolas Pike.

Dr. H. L. Carroll, on behalf of the Committee on the American Association for the Advancement of Science, reported that a successful excursion had been enjoyed to Sandy Hook, on August 15, in connection with the Torrey Botanical Club and the visiting botanists and entomologists of the association.

The American Ornithologists' Union held its annual meeting at the rooms of the Boston Society of Natural History, October 11 to 13, 1887. President J. A. Allen, of New York, occupied the chair. The secretary's and treasurer's reports were presented first, showing that the society had 25 foreign, 74 active, 46 associate, and 200 corresponding members. The foreign membership is limited to 25, the active to 100, the associate to 50, while the corresponding membership is unlimited in numbers. The treasurer's reports showed receipts of $1764, and expenditures of $1217. The council advised the incorporation of the Union under the laws of the State of New York. Some of the papers presented were of general interest and permanent value, while others were local lists of birds, and a few might even be enumerated as "cranky." Among the more prominent were, "An Account of the Life and Ornithological Work of the Late Prof. S. F. Baird," by Robert Ridgway, of the National Museum; "Cormorant Fishing in Japan," by P. L. Jouy; "A Bird-Wave," by Montague Chamberlain; "Nocturnal Migrations of Birds," by F. M. Chapman; "Minor Notes," by Colonel N. S. Goss.

The National Academy of Sciences held its autumn meeting at Columbia College, New York, commencing November 8, 1887. The following papers were read: "Seismoscopes and Seismological Investigations," T. C. Mendenhall; "On the Primary Specializations of the True Fishes," E. D. Cope; "A Study of the Behavior of Metals under Variations of Temperature," Wm. A. Rogers; "Chemism in its Relations to Temperature and Pressure," T. Sterry Hunt; "On the Mechanical Origin of the Structures of the Hard Parts of the Mammalia," E. D. Cope; "Progressive Series in Chemistry," T. Sterry Hunt; "Kilauea, a Basalt Volcano," J. D. Dana; "Circulation of the Sea through New York Harbor," Henry Mitchell; "On a Study of Color Contrast," Ogden N. Rood; "On the Relative Variability of Men and Women," W. K. Brooks; "On a New Form of Reproduction in Medusæ," W. K. Brooks; "On the Lucayan Indians," W. K. Brooks; "Experiments in Measurements of Statical Electricity in Absolute Units," A. M. Mayer; "On Potential as measured by Work: a Mathematical Discussion," A. M. Mayer; "A Comparison of Antipodal Faunas," Theo. Gill; "On a Discovery recently made in Connection with the Flight of Birds," W. P. Trowbridge; "On the Determination of Star Magnitudes by Photography," E. C. Pickering; "On the Constant of Aberration," A. Hall; "The Cretaceous Coals of Western North America," J. S. Newberry; "The Future of Gold and Silver Production," J. S. Newberry; "The Temperature of the Moon," S. P. Langley; "On a Method of making the Wave-Length of Sodium-Light the Absolute Standard of Length," A. A. Michelson and E. W. Morley.